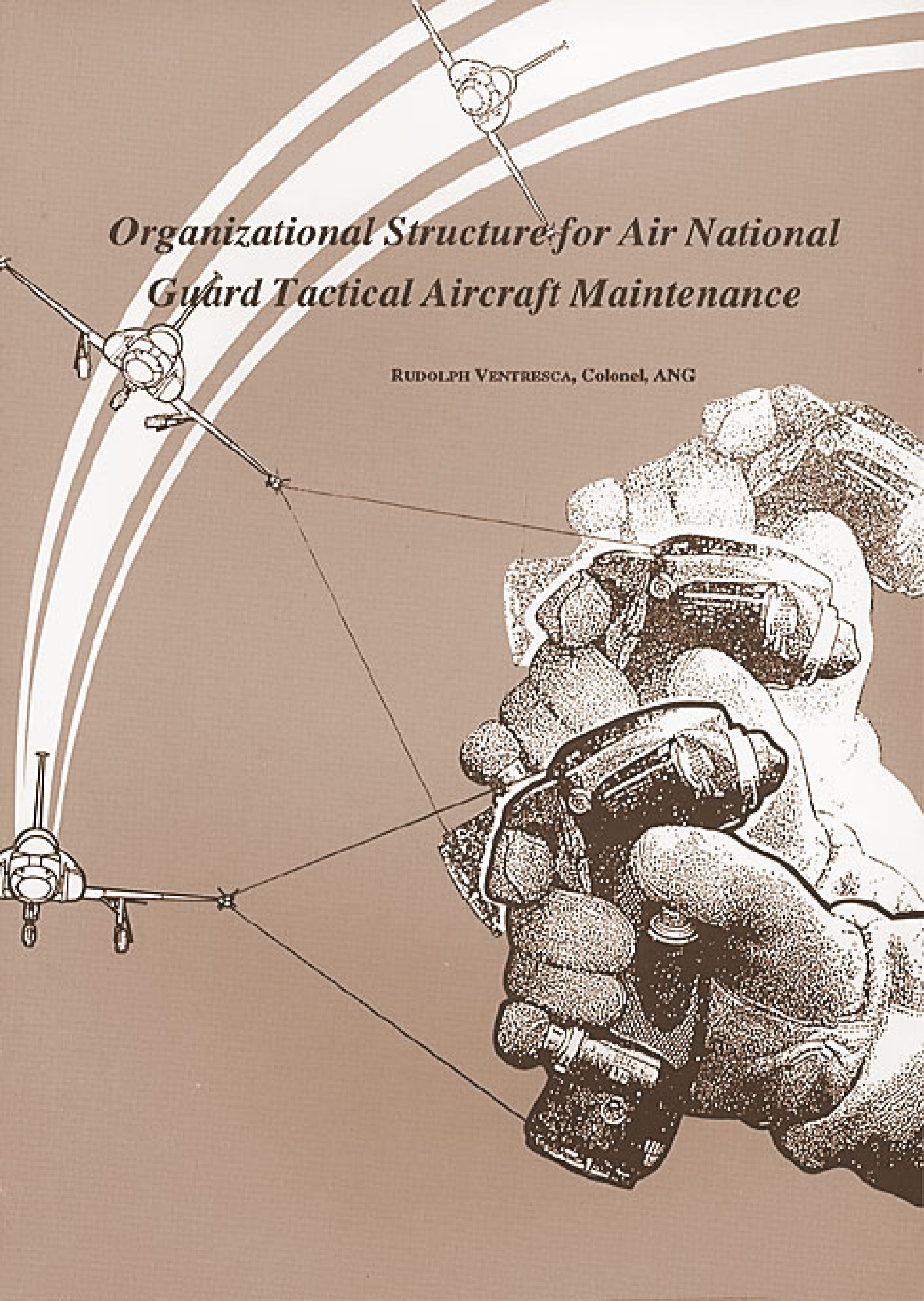
Organizational Structure for Air National Guard Tactical Aircraft Maintenance

RUDOLPH VENTRESCA, Colonel, ANG



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by

RUDOLPH VENTRESCA, Colonel, ANG
Research Fellow
Airpower Research Institute

Winner of the Air Force Historical Foundation's 1990 Colonel James Cannell Memorial Award

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To The Forgotten Mechanic

Through the history of world aviation
Many names have come to the fore.
Great deeds of the past in our memory will last
As they're joined by more and more.

When man first started his labor
In his quest to conquer the sky.
He was designer, mechanic, and pilot,
And he built a machine that would fly.

But somehow the order got twisted
And then in the public's eye,
The only man that could be seen
Was the man who knew how to fly.

The pilot was everyone's hero.
He was brave, he was bold, he was grand
As he stood by his battered old biplane
With his goggles and helmet in hand.

To be sure, these pilots all earned it.
To fly you have to have guts,
And they blazed their names in the Hall of Fame
On wings with bailing wire struts.

But for each of these flying heroes
There were thousands of little renown.
And these were the men who worked on the planes
But kept their feet on the ground.

We all know the name of Lindbergh
And we've read of his flight into fame.
But think if you can of his maintenance man
Can you remember his name?

And think of our wartime heroes:
Gabreski, Jabara, and Scott.
Can you tell me the names of their crew chiefs?
A thousand to one you cannot.

Now pilots are highly trained people
and wings are not easily won.
But without the work of the maintenace man
Our pilots would march with a gun.

So when you see mighty jet aircraft
As they mark their way through the air,
The grease-stained man with the wrench in his hand
Is the man who put them there.

Anonymous

Contents

Illustrations

Foreword

In the past, the Air National Guard (ANG) has been capable of assuming additional missions and training even while operating during times of tight operational and maintenance (O&M) budgets. We have been able to accomplish this because of an increased conversion rate to more reliable modern fighter aircraft, the high experience level of our personnel, and the stability of our forces due to low turnover. The dramatic changes that are taking place all around us, coupled with severely constrained budgets, make it imperative that we find ways to perform our mission more efficiently in order to maintain the high level of readiness for which the ANG has become recognized.

The maintenance organization of tactical air forces (TAF) throughout the Guard has operated under the concept of centralized control and authority delineated in Air Force Manual 66-1, *Maintenance Management Policy*, and Air National Guard Regulation 66-14, *Maintenance Management, Air National Guard*, the aircraft maintenance "bible." This concept has worked well in the past considering the relatively stable environment in which we operated. In today's rapidly changing environment, however, this might not be the most efficient way to continue operating.

Colonel Ventresca provides insight into the Air National Guard TAF maintenance organization. He chronicles the past, reviews the present, and projects the reader into the future, taking into account those things that will likely affect the way we are organized and operate.

The entire maintenance organization must be modernized at one-third the Guard's total strength to put the skilled technician at the right place, with the right part, at the right time for a fix as soon as possible after the aircraft malfunctions. This must be done if we are to keep pace with a dynamic environment and to improve our ability to meet future needs efficiently and effectively.

PHILIP G. KILLEY
Major General, USAF
Director, Air National Guard

About the Author

Col Rudolph Ventresca

Col Rudolph Ventresca graduated from Clarion State College with a bachelor's degree in secondary education in the teaching fields of chemistry, physics, and mathematics. In 1962 he joined the Air Force and entered Officer Training School at Lackland Air Force Base (AFB), Texas. After being commissioned in March 1963, he was assigned to the Lowry Technical Training Center for nuclear weapons officer training at Lowry AFB, Colorado, and subsequently to West Germany in November 1963. In 1966 he began serving as the maintenance supervisor in the 51st Munitions Maintenance Squadron of the Strategic Air Command (SAC), Vandenberg AFB, California. He attended the Explosive Ordnance Disposal School at Indian Head, Maryland, in June 1967 and a year later was assigned to Bien Hoa Air Base (AB), South Vietnam, as the base explosive ordnance disposal officer. After serving a one-year tour, he returned to Wurtsmith AFB, Michigan, as the maintenance supervisor and commander of the 67th Munitions Maintenance Squadron (SAC).

In 1971 he was again sent overseas, this time to Headquarters Thirteenth Air Force, Clark AB, the Philippines, as the operations division chief within the Directorate of Munitions. In 1973 he was assigned as chief of the Reentry Vehicle Branch of the 351st Strategic Missile Maintenance Squadron (SAC) at Whiteman AFB, Missouri. He left active service in June 1975 and joined the Air National Guard (ANG) at Selfridge ANG Base, Michigan, where he progressed from the nuclear weapons officer in the 191st

Fighter Interceptor Group (FIG) of the Air Defense Command (ADC) to avionics officer in the 127th Tactical Fighter Wing (TFW) of the Tactical Air Command (TAC), to maintenance control officer in the 127th Consolidated Aircraft Maintenance Squadron (CAMS), and finally to deputy commander for maintenance, the position he currently holds. In 1989 the ANG selected Colonel Ventresca to be its command-sponsored research fellow and to attend Air War College.

Colonel Ventresca earned a master's degree in business from Central Michigan University in December 1981 while assigned to Selfridge ANG Base. His professional military education includes Squadron Officer School, Air Command and Staff College, Industrial College of the Armed Forces, and Air War College.

Colonel Ventresca and his wife, Rebecca, have two sons, Ricky and Ralph.

Preface

Over the past 25 to 30 years, the active Air Force has made dramatic changes in the organization and structure of fighter aircraft maintenance units, while Air National Guard (ANG) maintenance units have remained substantially the same. The acceptance of the gaining-command concept in 1960 effectively bound the ANG to abide by the training and policy guidelines of the active Air Force. According to this concept each Air National Guard unit is aligned by mission with an active Air Force major command. During peacetime each major command is responsible for providing policy guidelines and monitoring the training of each of its designated units to include conducting operational readiness inspections (ORI). Upon mobilization the various Guard units are integrated with their gaining command to complete a total force structure capable of meeting wartime contingencies. The Vietnam experience taught us some lessons about organizing for combat and training the way we plan to fight. The active tactical air forces (TAF) responded to those lessons learned and to a changing environment by changing the structure of their maintenance organization. The changes that were made could affect the ANG's ability to integrate with the active forces when mobilized and to interact with them during peacetime training, exercises, and deployments.

This study analyzes and assesses the changes in organization and structure of the active Air Force and ANG fighter maintenance units from the time the ANG became a separate reserve component in 1946 to the present-day organization, paralleling it with the active Air Force. It takes the reader from the ANG maintenance unit's beginning, through the changes that occurred over the years and the reason for the changes, to the present-day organization. It then provides a glimpse at the future maintenance organization.

Chapter 1 reviews current theory on organizational structure, Air Force and ANG doctrine, and the policy guidance from each major command and the ANG. It shows what theorists say about how an organization should be structured and what organizational philosophy has emerged from past learning and experience.

Chapter 2 evaluates the current ANG fighter maintenance structure by comparing it with the active TAF structure from the perspective of centralization and decentralization. It describes the organization of active and ANG TAF maintenance units and reviews their structure and their strengths and weaknesses based on current theory, philosophy, and mission. It explains why the ANG and active TAF maintenance units are organized the way they are by reviewing and comparing the use of personnel, ANG-unique capabilities, procedures for establishing manpower requirements, and the impact of ancillary training and Rivet Workforce.

Reorganizing to mirror the TAF combat-oriented maintenance organization (COMO) potentially will require the expenditure of additional funds. Chapter 3 assesses only the cost of acquiring and training additional maintenance personnel, and it compares the ANG's operating and support costs to those of the active Air Force in terms of overall percentage of the budget

Chapter 4 first examines those factors that will affect the ANG maintenance organization and structure. It then identifies and refutes principal objections often heard about adopting COMO. Finally, it describes an enhanced ANG fighter maintenance organization structured to embody all the principles of good organization. Such an organization would have improved repair capabilities using high technology, reliability and maintainability (R&M), and new management and leadership initiatives; and it would be compatible with the active TAF maintenance organization.

Rudolph Ventresca

RUDOLPH VENTRESCA, Col, ANG
Research Fellow
Airpower Research Institute

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I also want to specifically mention and personally thank the others who played a major role in assisting and supporting me during this same period of time. First, I want to thank Brig Gen David T. Arendts, the 127th Tactical Fighter Wing commander, for his support and confidence in me. He encouraged me to become a command-sponsored research fellow at ARI and to attend Air War College despite my reservations and the fact that our unit was scheduled for an operational readiness inspection and had received extremely short notice of its conversion to the F-16 fighter during my absence. A special thanks goes to Col Greg Maciolek, 191st Fighter Interceptor Group commander, for his strong support. He took a special interest in securing my acceptance at ARI and Air War College by writing a very complimentary letter of recommendation and making phone calls on my behalf. Thanks also to Col Paul Pochmara, director of operations at the Air National Guard Support Center (ANGSC), who likewise supported the recommendations made for me and encouraged me to accept the ARI challenge. I want to thank Lt Col Manfred Koczur for his efforts as "counselor" in giving his time to raise my spirits and help me go on during the many occasions when I felt overburdened.

Most important, I want to express my sincere and loving appreciation to my wife for managing our teenage children and our home during my assignment at ARI. Her frequent contact with me, continual encouragement, and strong moral support was a primary factor in ensuring my success in completing both ARI and Air War College.

Chapter 1

Aircraft Maintenance: Past and Present

Since the establishment of the air arm within the Signal Corps in 1907, aircraft have evolved from simple systems to today's highly specialized weapon systems. The simplicity of the early aircraft made it possible for one person (a "generalist") to work on all systems. Sometimes the pilot himself maintained the aircraft. If he did have a mechanic, the pilot simply discussed the problem with the mechanic and later made a check flight to determine if the problem had been corrected. Aircraft maintenance has undergone drastic changes since those days. Today it cannot depend on one person to have expertise in all systems but must rely on many technical experts with specialized knowledge to maintain every subsystem of the aircraft.[1]

The roots of Air National Guard aircraft maintenance date back to the formation of the First Aero Company of the New York National Guard in 1908. At that time the organization consisted of various and sundry units in several states formed by aviation enthusiasts who were interested in balloons and aircraft.[2]

For a period of eight years, from 1912 to 1920, National Guard aviation stagnated due to little state or federal support for further development.[3] After World War I, National Guard aviation units became known as aero units and subsequently as air observation squadrons.[4]

During these early years there was no formal tie between the Air National Guard maintenance organization and that of the active air forces. However, when Headquarters USAF standardized the organization after World War II, the ANG logically and voluntarily matched its maintenance organization with the active air forces. Not until the acceptance of the gaining-command concept in 1960

did the ties between the active and ANG components become formalized.

The advances in technology over the past eight decades have led to changes in the organizational structure of the aircraft maintenance function, with each change being designed to improve the combat readiness of the aircraft. Prior to 1911, there were no published rules or procedures related to the care and maintenance of aircraft. Nor was there a need prior to that time to establish any maintenance organization below division level. In that year, however, Lt Benjamin Foulois was assigned the task of developing a document to cover such matters. The result was "Provisional Airplane Regulations for the Signal Corps, United States Army, 1911." This document contained information on the care, repair, and maintenance of aircraft; the responsibilities of crew chiefs and mechanics; inspection duties and responsibilities of pilots, crew chiefs, and mechanics; and the initial provisional organization of an aero company, including the personnel required to repair and maintain the aircraft.[5]

By 1917 the aero squadron had developed as the basic tactical unit. Commanded by a major, it was divided into three companies, each having four airplanes. Each company was further divided into four sections, headed by lieutenants who were responsible for supervising repairs to the aircraft assigned to their particular section. In addition to the lieutenant, whose primary duties were as pilot or observer, each section had a number of enlisted aviation mechanics. Although the squadron commander was responsible for the upkeep and repair of all aircraft, engines, and equipment assigned to the squadron, each section was responsible for maintaining the aircraft assigned to it (fig. 1).

By the time the war ended in 1918, the aero squadron organization consisted of four sections: Headquarters, Engineering, Supply, and Flying. The Engineering Section was responsible for repairing airplanes, motorcycles, trucks, and automobiles. A crew chief, whose crew consisted of an assistant and three mechanics, was responsible for the condition, care, and preservation of the aircraft in and out of the hangar (fig. 2).[6]

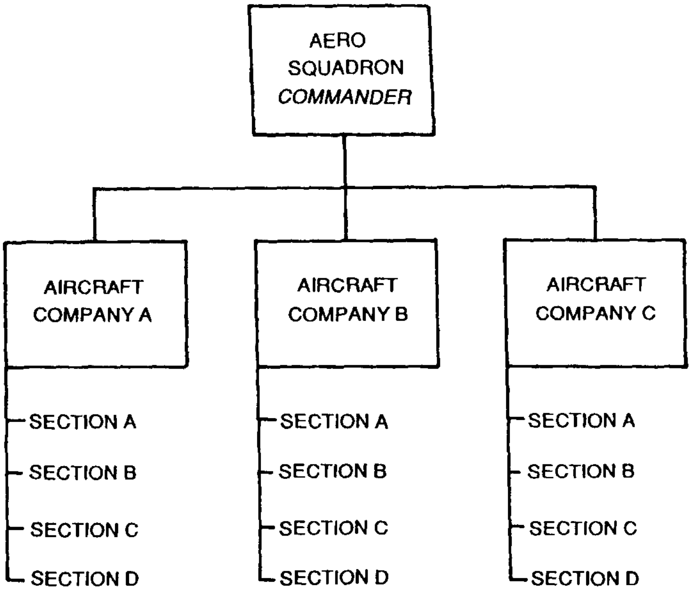
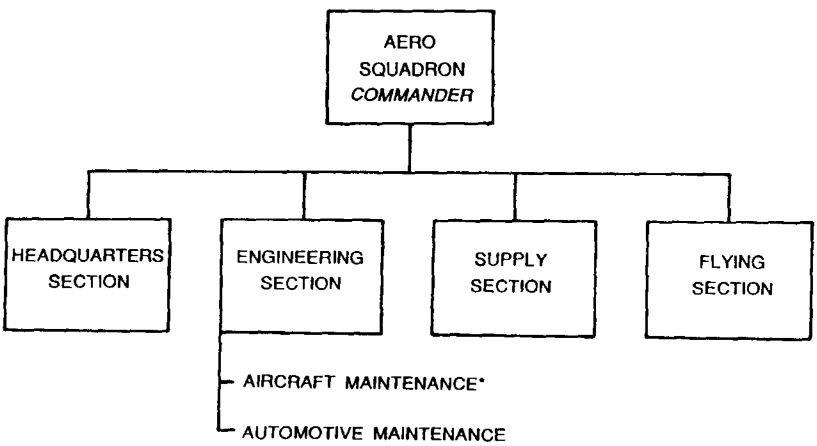


Figure 1. Pre–1917 Aircraft Maintenance Organization



*Total aircraft maintenance effort by the crew chief and his crew , in and out of the hangar.

Figure 2. Post–1918 Aircraft Maintenance Organization

Centralized Control, 1930–45

During the interwar period, there were significant advances in aircraft technology. Aeronautical engineering developed and tested the all-metal airplane of monocoque construction. It also made advancements in radios, instruments, and armament. The addition of new avionics and armament systems ushered in the age of specialization. The crew chief was now a master mechanic heading a crew that was trained in all aircraft systems except avionics and armament. Specialists who were not part of the crew maintained these systems. They belonged to collocated service squadrons that had been established to perform maintenance outside the expertise of crew chiefs and their crew.[7]

The advent of modern aircraft necessitated revolutionary changes in aircraft maintenance. The all-metal construction of aircraft spawned a new class of skilled technicians who performed welding and riveting tasks. The arrival of "modern" aircraft as well as the beginning of World War II marked a significant change in Army Air Corps maintenance. The maintenance course at Chanute Field, Illinois, was shortened, and the crew chief method of training was replaced by shortened courses that trained specialists in every aircraft subsystem. The result was a change in the crew chief system and the introduction of specialists into every facet of aircraft maintenance. At the same time, draftees and enlistees who were qualified welders, sheet metal workers, and other kinds of craftsmen in civilian life were assigned directly to the appropriate maintenance shop without any formal training. These requirements and actions caused a modified crew chief system to come into being. This system included a crew chief with a crew of mechanics. Some mechanics worked on the overall aircraft frame, and some were aircraft engine specialists. These mechanics were responsible for flight-line and periodic maintenance; there was also a pool of specialists located within the squadron to help the ground crew.[8]

Limited numbers of aircraft, limited supplies, inexperienced maintenance personnel, plus extensive flying time requirements

further prompted specialization to enable trainees to become proficient more quickly. A "dock system" of maintenance was established, wherein functional teams accomplished scheduled inspections in accordance with jobs that were sequenced for each task. Maintenance personnel were trained to do only those specific tasks that enabled them to be proficient in a short time. This dock system—coupled with specially trained crews who performed engine, carburetor, cylinder, and other changes—improved production and quality and therefore increased the number of aircraft available for training.[9]

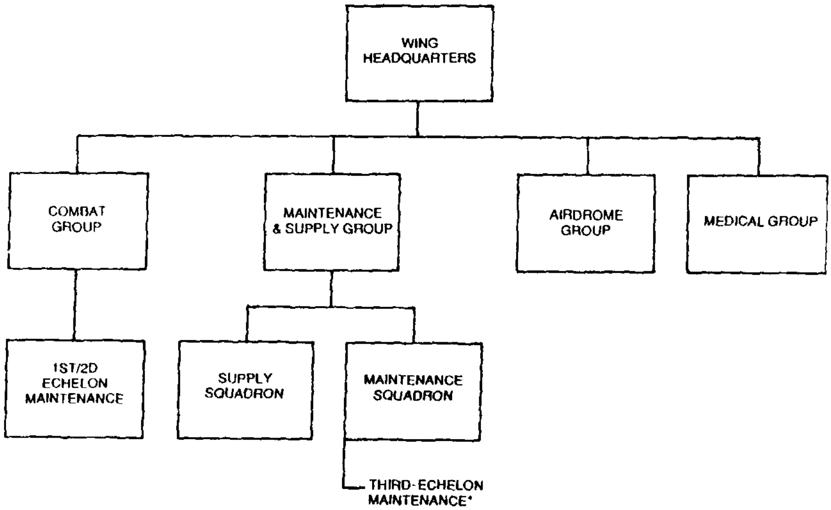
An Army Air Forces circular issued in 1944 summarized the impact of specialization on aircraft maintenance:

> The increased size and increased number of units, gauges, and mechanical devices on modern aircraft has reached such proportion that no one individual can possibly personally supervise and direct the detailed procedure in the operation, repair, and maintenance of that aircraft and its accessories. It is doubtful if there is any one man existent who could identify all of the different items requiring maintenance in the average combat aircraft. . . . It appears feasible that maintenance personnel as assigned to those groups should be pooled and then broken down into numerous specialized units, in order that there may be within each group sufficient specialist and available manpower to quickly accomplish any of the many specialist repair and maintenance functions required.[10]

Period of Uncertainty, 1945–55

The wartime need for specialization, coupled with the ever-increasing complexity of aircraft, made the move to specialization inevitable after World War II. This move spelled the end of the old "master mechanic crew chief system." There was a need for a new set of maintenance procedures and an organization that could better respond to training and wartime needs. US Army Strategic Air Forces Regulation 65-1, *Combat Maintenance Procedures*, filled that need in August 1945. It established a centralized maintenance section with strong central control of specialized maintenance organizations.[11]

In 1947 Headquarters USAF standardized the wing/base organization according to what was called the "Hobson Plan." Under this plan, the base structure was centered around the wing headquarters, which was the highest level of authority on the base. Under the wing were four groups: the combat group, the maintenance and supply group, the airdrome group, and the medical group. Inherent in this organization was a three-echelon maintenance concept that evolved in the postwar Air Force. The three echelons were organizational-, field-, and depot-level maintenance—all of which exist today. The maintenance and supply group consisted of a supply squadron and a maintenance squadron. The maintenance capability was located in two places: the combat group, which had maintenance responsibility for first- and second-echelon maintenance on base and transient aircraft and for engine changes; and the maintenance squadron, which was responsible for all third-echelon maintenance (fig. 3).[12]



*Third-echelon maintenance was equivalent to depot level during this period.

Figure 3. Post–World War II Aircraft Maintenance Organization (1955)

The Strategic Air Command then followed up in 1949 with SAC Regulation 66-12, *Maintenance Management*, which established a functional organization with maintenance control at wing level and three maintenance organizations on the base: organizational maintenance, field maintenance, and base and transient maintenance.[13]

Maintenance structures changed during the postwar period from 1945 to 1955, with each command instituting its own system, but the concept of the crew chief with specialized support prevailed within the organizational maintenance structure of the operational squadron.[14]

Return to Centralization, 1955–70

"A Résumé of a Study of the USAF Concept of Maintenance," an unpublished report by Headquarters USAF in 1950, formed the basis for the US Air Force's guidance to the major commands on aircraft maintenance and was published in 1953 as Air Force Regulation (AFR) 66-1, *Maintenance Engineering: Policy Objectives and Regulations*, and in 1956 as Air Force Manual (AFM) 66-1, *Maintenance Engineering: Policies, Objectives, and Responsibilities*.[15] Its adoption was initially optional for the major commands but became mandatory throughout the Air Force two years later. In 1960 the gaining-command concept was adopted by the Air National Guard to form closer ties to the active Air Force in terms of participating in joint exercises, reconnaissance missions, and firepower demonstrations. Gen Joseph H. Atkinson, the commander of Air Defense Command, asserted that so far as possible, ANG squadrons should be trained to the same level of proficiency as their active Air Force counterparts. The gaining-command concept required standardization of the Air National Guard's organizational training and operational readiness in accordance with the directives of the Air Force.[16] Consequently, the ANG's maintenance organization structure was modified to mirror the gaining-command structure. Furthermore, because of the increasing complexity and need for control, the centralized

organization delineated in AFM 66-1 was formed and called a consolidated aircraft maintenance squadron (CAMS).[17]

The new maintenance management concept grew out of the need to keep pace with the rapid new technological developments in weapon systems. Specialization and centralized control were established along functional lines with a single maintenance manager who had a staff to assist in the centralized control. This single maintenance manager was called the chief of maintenance and was responsible to the wing commander for all aircraft maintenance on the base.[18]

In Southeast Asia, the structure of the maintenance organization was changed again because Pacific Air Forces (PACAF) exercised the command option authorized in AFM 66-1 by publishing PACAFR 66-12, *Maintenance Management*. The tactical flying squadron absorbed the organizational maintenance squadron and loading crews. The Air National Guard was organized under the provisions of AFM 66-1, which had been the case since the gaining-command concept was adopted in 1960. The Tactical Air Command had become aware in the meantime that some organizational changes would have to occur if it was to meet its tactical mobility requirements. The "TAC Enhancement" program was instituted and provided for on-equipment maintenance and for support personnel to augment the flying squadron to create an independent operating entity. During the demobilization that followed the Vietnam War, both PACAF and TAC reverted to an AFM 66-1 structure because of the consolidation of resources to reduce redundancy and costs.[19]

Decentralized Control, 1970 to the Present

After the Vietnam War, the Air Staff initiated a maintenance posture improvement program in search of new ways to perform aircraft maintenance more efficiently and effectively. Tactical Air Command's response was the production-oriented maintenance organization (POMO). Under this concept, maintenance resources were categorized into two functions and three new squadrons were

created—the aircraft generation squadron (AGS), the component repair squadron (CRS), and the equipment maintenance squadron (EMS). All on-equipment maintenance was assigned to the AGS. Those tasks accomplished on the aircraft weapon system itself are categorized as on-equipment maintenance and include servicing; performing preflight and postflight inspections; launching and recovering; and lubricating, adjusting, and replacing parts, assemblies, and subassemblies. All off-equipment maintenance was assigned to the CRS. Off-equipment tasks include testing, troubleshooting, repairing, and modifying line replaceable units and shop replaceable units and are usually performed off the weapon system in the shop. The EMS performed aerospace ground equipment (AGE) maintenance, corrosion control, and transient maintenance. Centralized control of the maintenance effort was retained in maintenance control and the chief of maintenance and staff organization remained as specified in AFM 66-1.[20] The Air National Guard elected not to reorganize its maintenance functions and has continued to operate within the purview of AFM 66-1 under the centralized maintenance structure. Both the Air National Guard and the Tactical Air Command exercised the option of using either the formally recognized POMO—AFR 66-5, *Communications Security (COMSEC) Equipment Maintenance and Training*—or the standard maintenance organization in AFM 66-1.[21] With the POMO structure came the reappearance of the term *generalist* like a ghost out of the past because specialists were again assigned to the organizational maintenance unit and trained to do other jobs that were not directly related to their primary specialty.[22]

In the early 1970s, the Tactical Air Command, followed by the other tactical air forces, transitioned to yet another maintenance organization called the combat-oriented maintenance organization (COMO). The main purpose of COMO is to "provide a tactical aircraft maintenance support structure with the mobility and flexibility to survive in a dispersed environment and sustain combat operations."[23] The emphasis is on decentralization of the maintenance function, which, when combined with a tactical

fighter squadron, provides to the small unit the autonomy that is necessary during dispersed operations. The COMO is designed to be flexible enough to meet tasking in any mode whether by wing, squadron, or detachment. The Air National Guard again chose not to reorganize but instead published Air National Guard Regulation (ANGR) 66-14, *Maintenance Management, Air National Guard*, which contained the ANG's maintenance management policy of centralized control. Other major commands again opted to utilize AFM 66-1 or some other organizational form to meet their mission needs.

Lessons Learned

The TAF maintenance organization throughout the Air Guard has operated for the past 30 years under the concept of centralized control and authority delineated in AFM 66-1 and more recently in ANGR 66-14. This maintenance management concept has been adequate in peacetime given our authorized manning levels and unique ANG capabilities. However, opinions are mixed as to how well the AFM 66-1 system worked in the past during mobilizations and deployments for both active and ANG forces. In 1968 Headquarters PACAF's director of maintenance and logistics (DML) included in the Corona Harvest report a letter that stated:

> The entire success of this combat effort can be laid to the continuance of the sound maintenance management principles utilized in the 1960–1965 era. The system of organization allowed for rapid expansion of maintenance capability, enabled the addition of manpower to existing structures in large quantities, merging of numerous extraneous activities under a single manager and still produce quantity without sacrificing quality. The obvious result was proof that the AFM 66-1 system could "go to war, produce and survive."[24]

Others who were involved intimately with various aspects of the AFM 66-1 system during that same period do not share the same views. The Corona Harvest report goes on to say that the TAC squadron maintenance concept developed for mobility was adopted by PACAF. There were four squadrons—organizational

maintenance squadron (OMS), field maintenance squadron (FMS), armament and electronics maintenance squadron (AEMS), and munitions maintenance squadron (MMS)—in the PACAF structure, which was changed to place flight-line personnel and weapon loaders under the tactical squadrons. A single maintenance manager, the chief of maintenance, was responsible to the wing commander for overall wing aircraft maintenance although the flight-line personnel and weapon loaders were assigned to the fighter squadron. This structure caused problems. "The entire wing/squadron maintenance situation as prescribed by AFM 66-1/PACAF Supplement 1-1, dated 20 September 1966, left much to be desired. It was a compromise between two systems that satisfied neither operations nor maintenance."[25]

The Air National Guard Corona Harvest report submitted for the period 1 April 1968–31 December 1969 reflected some underlying problems as well: "During the active duty period, it became obvious that USAF was *not aware* of the basic difference in prefederalization structure between those of Air Force units and ANG groups."[26] This statement was made by a Security Police superintendent who said that the Air Force was not aware that the ANG was organized with a small tactical fighter squadron because they were always surprised when strengths of 35 were reported and they expected hundreds. "It indicated a nonawareness between USAF and ANG of manning structures."[27] Although these statements were not related directly to the maintenance structure per se, they were an indication that similar problems probably existed throughout the ANG organization. Further evidence of organizational structure problems became apparent as a result of a questionnaire completed at MacDill AFB, Florida, for the ANG Corona Harvest report. TAC had decentralized base maintenance, which caused some problems in obtaining necessary AGE and equipment authorizations. "The base field maintenance squadron had recently been reorganized under the TAC Manual (TACM) 65-2 concept. The result was a 'quasi-TACM 65-2/66-1 arrangement' which was totally unsatisfactory."[28]

Finally, the ANG Corona Harvest report's recommendation was that the "maintenance organization and policy of TAC, PACAF, and USAFE should be monitored at USAF level and made as similar as possible."[29] In retrospect, this was a foretelling of the changes in the TAF maintenance organization that would occur in the next decade.

What becomes clear through all of this is a preponderance of evidence pointing toward a need to review our current organization to determine if change is needed. The first reason for concern is the evolution of the active gaining command over this period from an AFM 66-1 organization to POMO to COMO while the Air National Guard has not made any parallel changes. Second, the frequency and extent of ANG tasking by the Air Force has grown at a rapid rate over the past few years with more to come. Forced personnel strength and budget reductions have caused drastic measures to be taken by the active services to reduce the authorized wings and some mission tasking. Members of the Air National Guard have been willing and able to accept much of the additional tasking created by the reductions but must now evaluate our capability to continue to accept future missions with current and projected manning and funding. It becomes apparent, then, that our organizational structure must also be evaluated to determine if we have the best posture possible to maximize our combat capability.

Current Organization Structure Theory: A Review

To put all this information in perspective, we need to answer some questions. First, What does organizational development research tell us about how organizations *should* be structured, and What do the theorists propose? Second, What is the current USAF/ANG guidance on organizational structure? A review of the material available is revealing. Management expert Peter F. Drucker says, "The right structure does not guarantee results. But

the wrong structure aborts results and smothers even the best directed efforts."[30] Another organizational theorist, Mark S. Plovnick, states, "Organization structure . . . represents the context within which organizational life takes place. If the structure does not support necessary behaviors among organizational members, organizational effectiveness is diminished."[31]

Cyrus F. Gibson argues that organizational structure is a dependent variable that accounts for the variety in organizations when influenced by four independent variables: outer environment, strategy, internal capabilities, and external social forces.[32] Furthermore, he says that research and theory on organizational structure in relationship to external environment "has led to the basic recognition that the appropriate organizational structure is largely a function of aspects of the organization's environmental context. That is, there is no one structure best for all organizations, and not all structures are equally good." To be appropriate, the organization's structure should be tailored to the characteristics of the particular environment in which it is operating rather than fitted to a standard or popular form, approach, or style. This is referred to as the "contingency theory" used in reference to organizational design and strategy for implementing change.[33]

Richard L. Daft and Richard M. Steers, like Cyrus Gibson, discuss contingency theory. They suggest that strategies and structure that are appropriate for an organization can be determined through understanding the contingencies among organizational variables and the external environment.[34] Still further research by Thomas J. Peters and Robert H. Waterman, Jr., indicates that a good, sound approach to organizing must include more than just a rearrangement of the boxes on the chart. They contend that it must take into consideration at least seven variables: "structure, strategy, people, management style, systems and procedures, guiding concepts and shared values (i.e., culture), and the present and hoped-for corporate strengths or skills."[35] As Gibson points out, formal organization structure is one of the most visible and recognized characteristics of organizations affecting its members' perspectives and behavior. "It is one of the key inputs available for

the exercise of indirect influence on perspective and behavior." He refers to the organizational structure as "a kind of skeleton of formal relationships among departments and individuals." Although the structure does not tell the whole story, nor is it necessarily the most important performance determinant, it is a starting point in the process of design and change.[36]

In order to effect organizational change, or any other kind of change for that matter, we need to know where we have been, where we are, and where we want to go. The organizational theorists like Gibson describe organizations to help us determine the answers to these issues and begin the process of evaluating the need for design or change. In an attempt to describe the ANG maintenance organization to address the issue of where we are, we have elected to use Gibson's *Managing Organizational Behavior*. His work parallels and documents the work of many other theorists and researchers in the field of organizational development. He describes four basic forms of organizations: functional (centralized), divisional (decentralized), overlay, and matrix. These are ideal forms, and very few organizations take the pure form. The Air Force tends to use the functional form, which is considered to be centralized, specialized, and capable of a high level of efficiency by taking advantage of economies of scale. The advantages and principles seem to be just as applicable today as they have been for thousands of years. By itself or in combination with other forms, the functional form is used by the majority of large and successful organizations.[37]

The functional form does have its disadvantages, including higher overhead costs and the need for increased manpower at staff level to facilitate the integration of the subunits. Another disadvantage is that because of the high level of specialization characterized by this form, the personnel tend to develop a narrow perspective of the organization, sometimes losing sight of the overall goals and mission and not seeing the forest for the trees. In a simple, stable environment where change is slow, the functional form can be the most effective and efficient. If the organization grows in size or if it experiences more rapid change, the adaptation

can be effected by further subdivision and simplification of subtasks by increasing skills and competence so that uncertainty can be handled at the employee level, and by allowing goal setting at the subunit level rather than imposing close control of routine work.[38]

Air Force and Major Command Policy Guidance

Air Force maintenance management philosophy and policy are aligned with the current theory of organizational development and structure. AFR 26-2, *Organization Policy and Guidance*, describes the principles and policies of Air Force organization, explains various organization units, shows standard structures, and gives procedures for establishing organizations and making changes. It identifies the overall objectives of Air Force organization: to maintain, within resource constraints and feasibility, a structure that avoids turbulence in the organization when transitioning from peace to war and to operate it effectively with the least amount of resource expenditure; to standardize as much as possible to promote stability and to facilitate management improvements Air Force–wide; and to measure and compare performance. Other objectives of Air Force policy are to keep pace with technological advances, changes, and concepts of operation; to streamline decision making by minimizing levels of review and having the simplest vertical organization possible; to ensure that organizational improvements are shared Air Force–wide; and to develop standard organizational nomenclature throughout the Air Force. The emphasis on wartime tasks, with the operational squadron as the basic deployment unit, has been the major determinant in achieving rapid reaction, mobility, and flexibility. As already mentioned, the Air Force takes the functional approach to organization rather than the process, self-sufficiency, or geographical approach. These organizational forms directly correspond to the types that Gibson describes.

AFR 66-14, *The US Air Force Equipment Maintenance Program*, comprises the Air Force's philosophical approach to equipment maintenance. It outlines policies and fixes responsibilities. The basic tenet of the philosophy is that there be assurance that weapon systems and equipment be maintained in a serviceable condition, be safe to operate, and be mission ready for use on a long-term basis for peacetime, wartime, and contingency operations. The regulation further defines maintenance production, maintenance engineering, and maintenance management—all functions of the equipment maintenance production program. Our organizations manage these basic functions and are impacted either directly or indirectly by them. They prescribe where maintenance is to be performed; who is to perform it; and when, and basically how, maintenance is to be performed. They also describe the levels of maintenance, maintenance tasks, and categories of maintenance.

Preventive maintenance is the key concept of the Air Force philosophy. It is contrasted with the other services' "fly-until-failure" philosophy, which allows systems to operate until they malfunction without regard to performing periodic scheduled maintenance based on hours of operation or flying hours. Preventive maintenance tasks are performed to avoid premature equipment failure by sustaining the designed and manufactured reliability inherent in reliability and maintainability (R&M) and reliability-centered maintenance (RCM) programs. The maintenance tasks are categorized as to where they are performed in relation to the end item of equipment or weapon system. This concept is the genesis of the terms *on-equipment* and *off-equipment* maintenance and is a major factor in the determination of organizational structure and use of personnel within that structure.

Maintenance engineering is the other major function that determines organizational structure and use of personnel within the maintenance organization. The purpose of the maintenance engineering function is to improve R&M of existing equipment

and to ensure optimum reliability during design and acquisition of new equipment.

The equipment maintenance philosophy prescribed in AFR 66-14 is also the basis for operating and supporting the command's policies on life-cycle management, especially in relation to past and future maintenance concepts. In the past, life-cycle concepts were derived from low mean-time-between-repair (MTBR) rates, high could-not-duplicate (CND) rates, and expensive line replaceable units (LRU). Therefore, an extensive intermediate-level maintenance support structure at the operating level was established because it was considered less costly. In the future, however, maintenance life-cycle concepts will focus on high state-of-the-art technology, mechanical design techniques, and human factors engineering. These considerations will, according to the philosophy, reduce frequency of component repair, which is a reliability factor. They will also reduce MTBR actions through effective design engineering, with the emphasis being placed on eliminating costly use of large built-in diagnostic systems to determine CND actions and why malfunctioning systems continue to test "OK." This is another factor in manpower and organizational structure at the operating level.

Future maintenance concepts will also affect our organizational structure because the requirement for an extensive off-equipment maintenance infrastructure will be minimized to include special facilities as well as less manpower-intensive maintenance organizations and less complex support equipment. Such concepts will reduce nonstandardization and the number and variety of maintenance skills, develop on- and off-equipment maintenance categories, take environmental factors into consideration, and minimize the need for large amounts of tools and equipment.

AFR 66-14 continues with other life-cycle management policies like reliability and maintainability and logistics support analyses that indirectly affect the organization. The readiness and sustainability policies outlined in the regulation affect organization from the standpoint of establishing overall criteria to be met, which

then affect how we would or should be organized to accomplish the required tasks.

Maintenance organizational policies form the broad basis for the types of organization identified in each maintenance management directive. Organizations must be structured for readiness through effectiveness and efficiency to emphasize maximum production with a standardized structure based on size; mission; and mission, design, and series (MDS), which should only include those functions required by mission and equipment. The manpower, personnel, and training policies address adequacy of authorizations and numbers of personnel. They require that the maintenance specialties to be developed for new weapon systems be system-specific rather than subsystem-specific. Equipment repair policies encourage the use of local manufactured equipment in order to improve self-sufficiency, and they develop scheduled maintenance requirements to include reliability-centered maintenance.

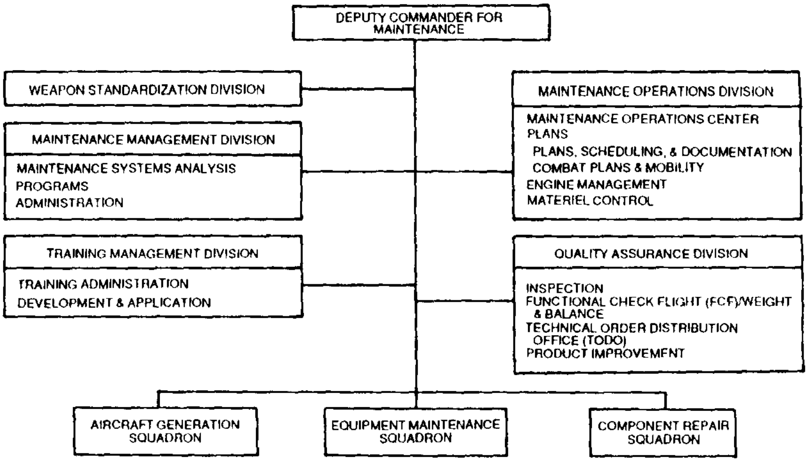
Air Force Regulation 66-1 establishes and implements the maintenance management system for the Air Force and Air Reserve Forces within the purview of the equipment maintenance program. The key tenets of AFR 66-1 policy stress that maintenance functions be organized and that personnel be assigned duties that will maximize production by eliminating nonproductive elements of the organization and emphasizing only those that are wartime essential; that peacetime and wartime tasks be balanced; that flexibility be designed into the organization to meet changing contingency requirements; that we look to the future in terms of policy, organization, procedures, and skills to ensure accommodation of missions, weapon systems, technology, and demographics; and that we ensure that all maintenance resources be adequate to meet mission requirements. These guidelines are intentionally broad so that the major commands will have the authority to implement and tailor the policies to meet their individual needs. The regulation also specifies that unit-level maintenance organizations be standardized within each major command based on size, mission, and weapon system.

Furthermore, maintenance activities must take into account their primary wartime mission and train in peacetime to meet that mission.

The vertical structure of the maintenance organization is specified to be in elements of the squadron, division, branch, and section, depending on the organization's mission, weapon system, and size. The regulation requires maintenance organization structures to be developed so that the wartime or peacetime mission tasking is the primary consideration; similar functions are grouped together, with span of control being a major consideration. Subject to the approval of Headquarters USAF, the National Guard Bureau, as a direct reporting agency, determines the Guard's organizational structure and the designations and sizes of its units.

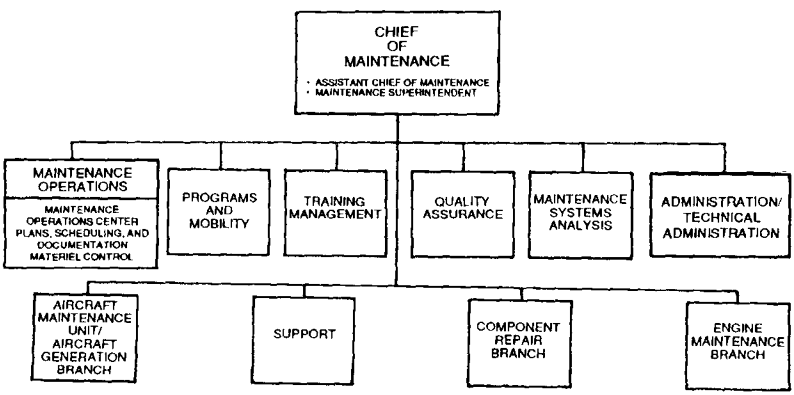
Multicommand Regulation (MCR) 66-5, *Combat Oriented Maintenance Organization (COMO)*, establishes the policy and procedures for the TAF and concurrently implements the provisions of AFR 66-14 and AFR 66-1. The policies are command-unique, which allows local deputy commanders for maintenance (DCM) the flexibility to make adjustments required due to differences in mission, facilities, or geography. Specific implementing procedures are included as chapters by each major command's TAF. The organizational structure specified for the TAF is shown in figure 4 for wing-sized units and in figure 5 for squadron-sized units. The organization is required to be structured according to size, mission, and weapon systems in descending order from wing to division to squadron to branch to section. Consolidation of sections within branches is allowed to promote efficiency and reduce costs. The squadron-sized units are to be designated by the major command, and their organizational elements must correspond to the wing-sized organization; that is, squadron to wing, branch to squadron, and section to branch.

ANGR 66-14 constitutes the maintenance management system of the Air National Guard. It establishes the maintenance responsibilities for the DCM and staff as well as for the four maintenance branches—organizational, field, avionics, and munitions. This regulation, which incorporates and implements



Source: MCR 66-5, *Combat Oriented Maintenance Organization*, 31 May 1985, 1–6.

Figure 4. Deputy Commander for Maintenance



NOTE: MAJCOMs may organize the functions shown to meet command requirements.

Source: MCR 66-5, 1–11.

Figure 5. Squadron-Sized Units

the provisions of AFR 66-1, recognizes the uniqueness of the ANG. It gives latitude to the DCM to meet the maintenance requirements of the unit while complying with the broad, general guidelines of AFR 66-1. ANGR 66-14 policy recognizes the need for compatibility with the gaining command and tasks the DCM to ensure that personnel are aware of any differences in the maintenance management programs so that problems may be minimized when their unit is mobilized. The policy is that during nonmobilized operations, the ANG maintenance units are not manned or structured to adopt all the policies and procedures of the gaining command. The organization is squadron-sized and similar in structure to what is shown in figure 5 in the relationship of squadron to wing, branch to squadron, and section to branch.

Notes

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2. Charles Joseph Gross, *Prelude to the Total Force: The Air National Guard, 1943–1969* (Washington, D.C.: Office of Air Force History, 1985), 1.

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13. Ibid.

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18. David C. Rutenberg and Jane S. Allen, eds., *The Logistics of Waging War: American Logistics, 1774–1985* (Gunter AFS, Ala.: Air Force Logistics Management Center, 1986), 150–51.

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20. Townsend, 44.

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25. Ibid., 243.

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27. Ibid.

28. Ibid., 5, 113–14.

29. Ibid.

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33. Ibid., 101–2.

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35. Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence: Lessons from America's Best-Run Companies* (New York: Harper and Row Pubs., Inc., 1982), 9.

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38. Ibid., 107–8.

Chapter 2

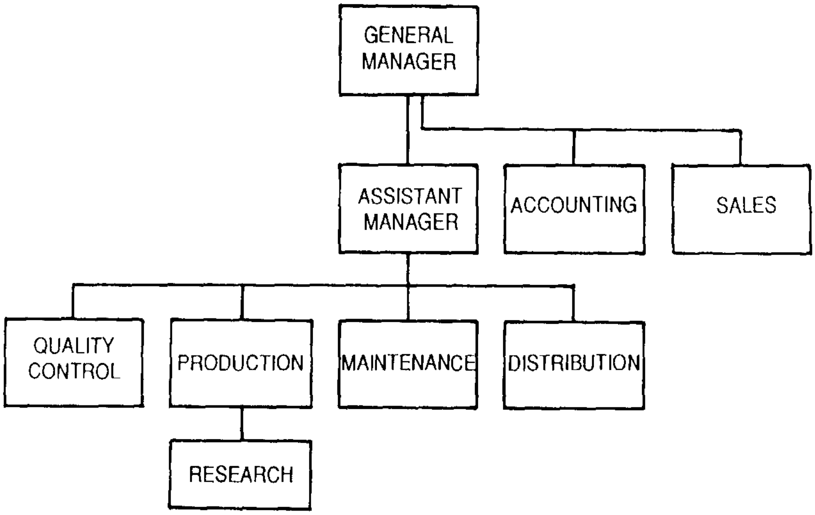
The Air National Guard Maintenance Organization and the Combat-Oriented Maintenance Organization

Over the past half-century there has been a rising tide of information, research, and theory on organizational development. In fact, this rising tide has swelled to tidal-wave proportions. Much of the debate about what is the right organizational structure centers around the functional and divisional organization; or, in broader terms, around centralized and decentralized organizations, respectively.[1] Robert I. McLaren relates the issue to a dilemma in which one structure is selected at the expense of the other. Furthermore, he goes on to say that centralized and decentralized organizations in their pure form can be thought of as being at extreme ends of a continuum.[2] There is no fully centralized or decentralized organization. Each is located on the continuum according to the degree that it embodies one of the two extremes. Whichever form is selected as the better one for an organization is a compromise between the two. Management must make the choice realizing this and then go about its business while constantly monitoring the external and internal environment for indicators of the need for change.

The Centralized Organization

A functional structure is one that is considered to be mostly centralized in decision-making authority because of the convergence of functions at the top. This is the most widely used type of organization. Its main feature is departmentalism according to tasks. Those who perform the same kind of tasks are grouped

together; like groups are placed in the same department, and like departments are placed under the same supervisor or manager (fig. 6). If problems develop between departments that involve more than one functional area, top managers make the decisions to resolve them.[3]



Source: Richard L. Daft, *Organization Theory and Design*, 3d ed. (St. Paul: West Publishing Co., c1989), 234.

Figure 6. The Centralized Organization (Functional Type)

The best type of structure depends on the organization's size, technology, environment, and goals. The functional-type structure is most appropriate for small- to medium-sized organizations that only deal with one or a very few products or services; that have good lateral communication; that have routine technology; that have a stable environment; and that have goals that include efficiency, quality, and technical specialization.[4]

Strengths

The centralized organization can use resources efficiently and economically because common tasks are grouped together. No duplication of resources occurs because all experts are in a single

location. In-depth skill development is possible because specialists are exposed to training and task performance in their area of expertise within their own department. The organization achieves unity of direction through centralized decision making. Top managers provide central coordination and control and major decision making. Finally, there is excellent coordination within the functional groupings when shared facilities, similar training, and experience help people to identify with functional goals and to exchange information necessary to accomplish functional tasks.[5]

Weaknesses

While communication and coordination *within* departments in centralized organizations is considered a strength, it is a weakness when applied *across* departments. There is a reluctance to compromise with other departments to reach established goals of the organization since employees identify with their own functional area. Integration mechanisms, such as task forces or committees, are necessary to achieve cross-functional coordination. The fact that senior managers make the major decisions causes overload and a "piling up" of decisions at the top, resulting in slow or bad decisions.[6]

The first two weaknesses mentioned combine to cause a third weakness. Since employees within the functional structure tend to be concerned with the goals and activities of their own functional area, response to changes in the external environment is slow and innovation is infrequent.[7]

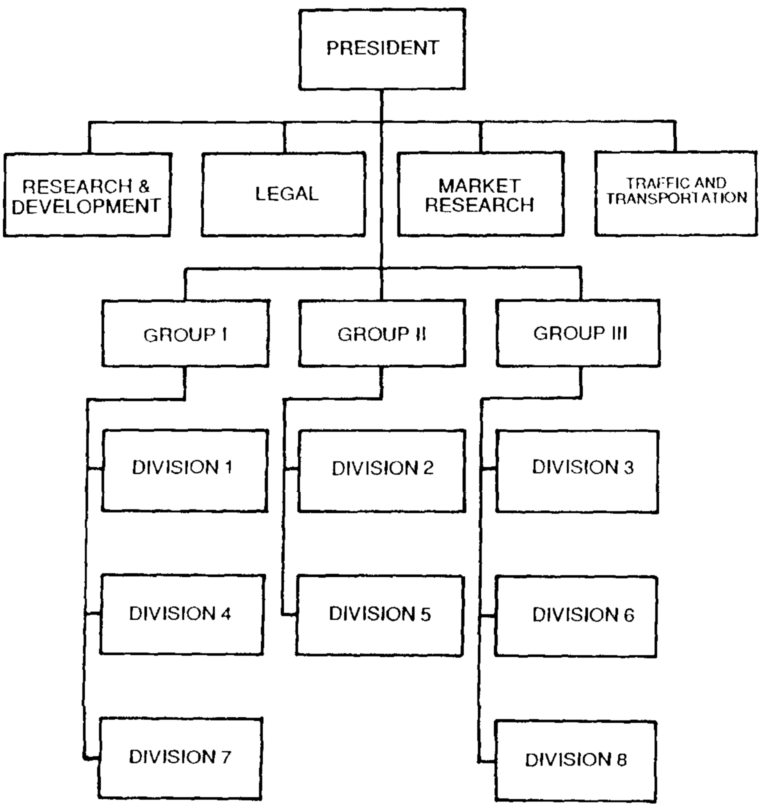
Responsibility for success or failure is difficult to discern in functional organizations. Activities that determine overall performance are conducted in individual functional areas, making it difficult to ascertain the contribution of each area to the success or failure of the organization. It is also difficult to determine the cause of each failure.[8]

Probably the most significant weakness inherent in the functional organization is the limited capability to develop general managers. The very nature of the functional structure inhibits

cross-training into other areas or departments because employees generally move up the hierarchy through performance of specialized activities within their functional area.[9]

The Decentralized Organization

The decentralized organization structure—sometimes referred to as divisional, self-contained, or hybrid—groups functions into autonomous departments or divisions that produce a product or provide a service (fig. 7). Departmentalization is based on output rather than on task, as in the functional structure. Decision-making responsibility is assigned to at least the next lower level of the



Source: Daft, 240.

Figure 7. The Decentralized Organization (Hybrid Type)

hierarchy to improve response time and coordination among functions. As you might expect, the decentralized structure is suited to large and complex organizations having enough resources to be subdivided into several self-contained units. This structure is very responsive to changes and is appropriate when each self-contained division depends on another for successful accomplishment of tasks that are consistent with product or service specialization rather than functional specialization.[10]

Strengths

The self-contained unit structure is capable of fast change in an unstable environment because each division is small and flexible and independent of the others. Client or customer satisfaction is high because each division specializes in a specific service or product. Customers therefore know which division to contact to resolve problems. Thus both success or failure can be pinpointed to a specific division.[11]

There is a high degree of coordination *across* functions. Identification with unit goals rather than with functional goals helps each department to compromise with others to reduce conflict.

The strength of the decentralized organization is one of the major weaknesses of the centralized one. General management training is readily accomplished because lower-level managers are trained to make decisions and to operate in an environment in which coordination across functions is emphasized.[12]

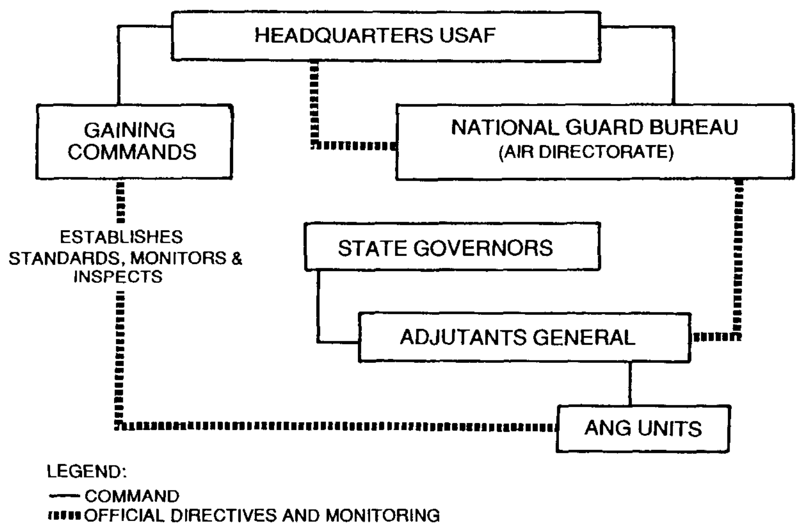
Weaknesses

Probably the major weakness of the self-contained unit structure is the duplication of resources. Instead of sharing common equipment and facilities, specialists may be divided and assigned to several different functional areas or departments where each might not be fully utilized. Other weaknesses include less in-depth technical specialization and expertise because people are concerned with the general skills needed to provide overall service

or to deliver a product, and there is less top management control because decision making is the responsibility of lower-level managers.[13]

The Air National Guard

The Congress of the United States is empowered by our Constitution to organize and arm a militia composed of citizen-soldiers under control of the governor of each state but subject to employment in federal service as might be required. As a modern component of that constitutionally established militia, the Air National Guard (ANG) is composed of part-time and full-time citizen-airmen organized and equipped to accomplish its state and federal mission. Under peacetime control of the governor of the state, the Air Guard's mission is to protect life and property and to preserve peace and order and the public safety (fig. 8). Its federal mission is to provide mission-ready combat flying units and combat support units capable of rapidly mobilizing as the primary



Source: *Air Reservist Magazine*, December 1975–January 1976, 3.

Figure 8. Air National Guard Wartime and Peacetime Command Structure

component in support of the Air Force in the event of war or national emergency.

The current ANG force structure consists of 91 flying units that have a total of 1,730 combat aircraft distributed among all the states, with each state having at least one unit. In fiscal year 1988 there were 115,200 personnel assigned to the ANG, of which approximately 27 percent were specifically assigned to aircraft maintenance. The other 73 percent makes up the operations, supply, and support units.[14] These flying units are organized as one-squadron groups or wings rather than three-squadron wings as in the USAF. Although certain Guard units carry wing designations and have groups administratively assigned in the same state or other states, they do not have operational control of their groups. The major distinction is that ANG wings usually have one flying squadron assigned with 24 primary authorized aircraft (PAA), and the groups have one flying squadron assigned with 18 PAA. Both organizations have an associated aircraft maintenance squadron. The wings and groups are not located together at one base.

The ANG has certain unique capabilities that serve as advantages to the total force and the Department of Defense (DOD). Of these, three relate specifically to force structure. First, economically threatened programs needed by the active Air Force are often preserved by transferring them to the ANG either permanently or until budgetary constraints and priorities are shifted. Second, and directly related to the first advantage, is the economic savings that are realized by the ANG's capability to perform certain missions and to maintain combat readiness at less cost than that of full-time standing armed forces. These cost savings are due to the full-time/part-time nature of the Guard's structure. Third, ANG members enhance their experience and job knowledge through close association with each other in the same organization over extended periods of time. The performance of the same mission with the same equipment and personnel develops skills, experience, and job knowledge that promote a high degree of efficiency.

Maintenance Training

The ANG maintains readiness through the use of full-time and part-time forces to conduct effective training on a continuous basis. The authorized maintenance personnel are divided between these forces in the ratio of one full-time technician to a little more than three part-time Guard members. Following induction into the ANG, new recruits receive the same initial training as their active duty counterparts. However, unlike active duty servicemen, the traditional Guard members return to their civilian occupations after initial training and are thereafter required to perform two days of inactive duty training (IDT) per month during unit training assemblies (UTA). An annual field training (AFT) period of 13 to 15 days of active duty training (ADT) per authorized position is allowed for Guard members to perform consecutive days of additional training with their units. These training periods provide a minimum level of proficiency to enable each individual to perform his or her wartime tasks.

The part played by the full-time force of military air technicians in maintaining combat readiness is critical. Much like their active duty counterparts, technicians receive training that provides the unit with the capability to maintain and fly aircraft on a daily basis. More important, though, the military air technician is the expert who must provide the vital training to the traditional Guard members during UTA, AFT, and other training periods to keep them proficient in their wartime skills. Clearly the division of the force in this manner not only maintains combat readiness to augment the active force but also makes maximum use of economy of scale and is therefore more cost-effective.

Ancillary Training

With limited time available to maintain minimum levels of primary skills training, it is of paramount importance to the Air National Guard that other requirements do not infringe on that time. Ever-increasing ancillary training is one type of requirement that tends to erode the critically limited time available for

maintenance training. Although necessary, training in numerous related subjects such as phase I and phase II security, operations security, communications security, buddy care, small arms qualification, and protection of the president has become a monster that slowly threatens to devour the time that is the lifeblood of our maintenance training program in the ANG. For example, the total time available to train the traditional Guard member is 312 hours per year.[15] The estimated time currently required to conduct ancillary training is 277 hours per year, or 88 percent of the total time available.[16] This requirement for ancillary training will have to be lessened to minimize its negative impact on primary skills training.

Project Rivet Workforce

Rivet Workforce (RWF) is a USAF initiative to consolidate maintenance Air Force specialty codes (AFSC). Although it is not implicitly a training program, it will initially have a major impact on the training time available to the ANG member. The overall goal of this program is to create a more flexible, mobile, and survivable force that can meet future employment concepts. We will address the Rivet Workforce program objectives that affect ANG maintenance training here and later those that affect the way maintenance operates.

The purpose of combining similar maintenance tasks to reduce the total number of specialists required is to expand the scope of responsibilities of each technician. The full-time military air technician will not be affected significantly by the transition to Rivet Workforce since many already have been trained in cross-utilization tasks. However, the initial on-the-job-training work load is increased, placing heavier demands on the time of the technician. Unlike ancillary training, the Rivet Workforce requirements apply directly to the primary duty task training that is needed to maintain war-fighting skills. Since the time available for training each technician is constant, training in other than wartime tasks will have to be reduced or modified in order to create

the desired outcome of a more highly trained and experienced force.

ANG Maintenance Organization and Operation

Upon mobilization in the event of war or national emergency, ANG units would be integrated with the active forces. The concern is whether or not ANG forces are organized and managed in peacetime in a way that they can be easily integrated with the gaining command during wartime. Otherwise, the ANG might find it difficult to learn the new system, which might create management problems initially. A detailed review of how a typical ANG maintenance unit is organized and operates will help clarify this concern and will provide a basis for comparison with the gaining command later in this chapter.

The structure of the ANG maintenance organization can be identified with the functional or centralized organization described by Richard L. Daft and Richard M. Steers, Cyrus Gibson, and other organizational development experts. It is the most basic type and is characterized by subunits, each of which has different technical specialties and clearly different tasks to perform. These subunits are the organizational maintenance branch (OMB), the field maintenance branch (FMB) or intermediate level maintenance branch, the avionics maintenance branch (AMB), and the munitions maintenance branch (MMB). A general management staff function integrates these subunits through the process of directing, planning, and controlling. Direct parallels can be drawn between the ANG maintenance management concept in ANGR 66-14, *Maintenance Management, Air National Guard*, and the way a functional or centralized organization operates as described by these theorists. The organizational structure depicted in figure 9 reflects the current physical form of the ANG maintenance organization as it would be upon mobilization. The commander is the senior manager at the squadron level. Staff members are pooled in the various functional areas shown to provide centralized support to the four different maintenance departments or branches

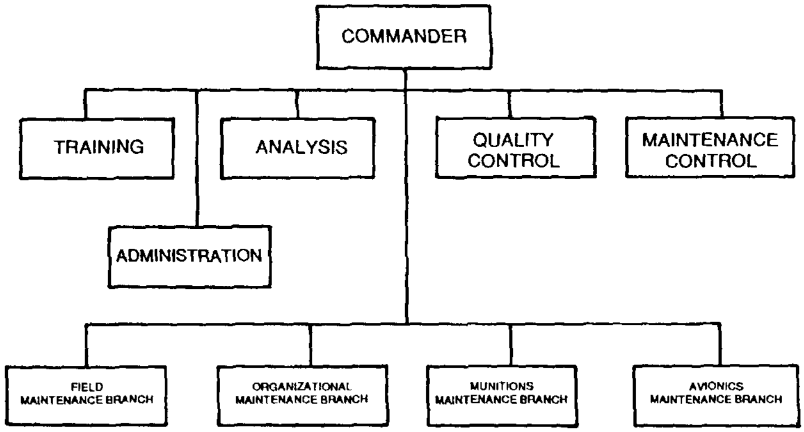


Figure 9. Typical Centralized Air National Guard Maintenance Organization

that are functionally grouped by the type of tasks they perform. Specialists are assigned to the field maintenance branch, avionics maintenance branch, or munitions maintenance branch and further subdivided into sections and shops that are responsible for maintaining specific systems on the aircraft. They are centrally directed and controlled by the authority vested in maintenance control.

The organizational maintenance branch performs tasks that are accomplished on the aircraft weapon system itself. These types of tasks are categorized as on-equipment maintenance. The organizational-level maintenance personnel are considered airplane general (APG) mechanics because their tasks are performed on the weapon system as a whole rather than on a specific subsystem.

During aircraft launches or recoveries, or any other time when repair actions are necessary, specialists with expertise in the affected system or subsystem are dispatched by maintenance control to the aircraft to perform on-equipment maintenance on that particular system. These specialists are capable of performing both on- and off-equipment maintenance. Off-equipment

maintenance is usually accomplished in a common facility (in shop) shared by other specialists and includes testing, troubleshooting, repairing, and modifying line replaceable units and shop replaceable units.

On- and off-equipment maintenance can be further categorized as scheduled and unscheduled maintenance. Scheduled maintenance is preventive in nature and consists of those type tasks that must be accomplished at periodic hourly or calendar intervals. Unscheduled maintenance consists of work on malfunctions discovered during flight or during inspections or other maintenance actions that require repair either prior to the next flight or some time in the future.

A typical but very simplified scenario will illustrate how an ANG maintenance organization operates. During a routine mission, the pilot's radio becomes inoperative. Upon landing, after being debriefed by maintenance at a centralized location, the pilot notes the radio problem in the aircraft forms. At the debriefing, the responsible functional area is tentatively identified and a job control number is assigned. Maintenance control receives the written discrepancy, verifies the responsible shop, and then dispatches a specialist to troubleshoot and to repair or replace the radio. If the radio were actually inoperative, the specialist would obtain a replacement item and take the faulty one back to the shop to perform the off-equipment maintenance authorized.

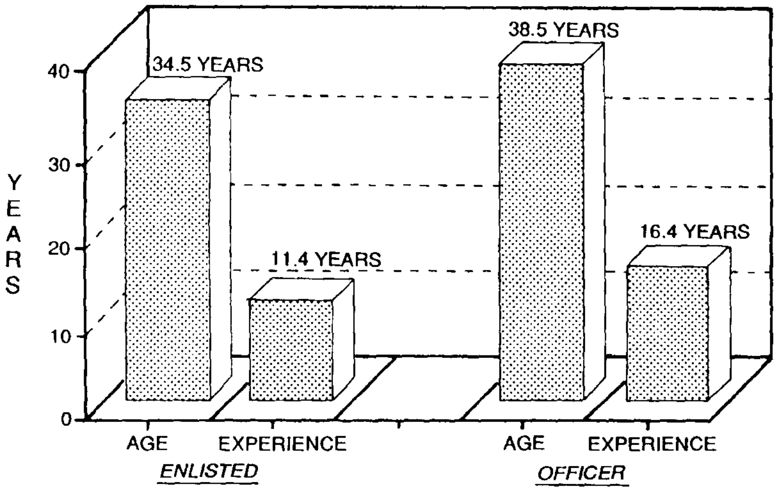
In this example, the direction and decision making was centralized in maintenance control and the action carried out by a specialized functional area. There are others in the hierarchy, such as the branch chief, who have some input into the decision made, but maintenance control has the ultimate authority. Consider now the situation in which there are maybe 10 aircraft flying during any particular period and multiple discrepancies occur on each one of them. Maintenance control might quickly become overloaded since it must make a decision about each discrepancy. Individual functional areas are concerned about repairing discrepancies identified as their responsibility; consequently, if a discrepancy is a result of integrated system or subsystem problems, repair actions

can sometimes be delayed until there has been cross coordination by maintenance control or until a specially formed committee communicates and coordinates across functional lines.

The implementation of Rivet Workforce will somewhat modify the ANG maintenance organization's structure as well as the way it operates. The 109 separate skills that previously existed will be consolidated into 96. The specialist that was dispatched by maintenance control in the example will not only be a communications expert but under Rivet Workforce will be trained in maintaining instruments used in navigation, flight, and maybe electronic countermeasures. This same kind of combination of skills occurs in every aircraft maintenance specialty. That is why the initial abundance of cross-training will have a significant impact on the ANG. Once the initial training is completed, however, follow-on training should not be a factor. In fact, training in some related skills will be reduced. Equally important to the way the ANG maintenance unit operates is the fact that the consolidation of skills mandated by RWF will lead to further separation of on- and off-equipment maintenance functions.

Manpower

The ANG has accepted the validity of the logistics composite model (L-COM) as the standard for determining manpower requirements in the aircraft maintenance area as applied to the centralized organization. L-COM is a computer-based model that simulates the various flight, maintenance, and supply activities that take place in ANG units. By using L-COM, we find that the maintenance manpower standard for a typical F-16 fighter unit with 24 primary authorized aircraft (PAA) is 553.[17] When applied across the spectrum of ANG flying units, the maintenance community consists of almost 33,000 officers and enlisted personnel. The average age of the ANG maintenance officer is 38.5 with 16.4 years of experience and the average age of the enlisted maintenance person is 34.5 with 11.4 years of experience (fig. 10).[18]



Source: Mary Phillips, ANGSC/DPD, telephone interview with author, 21 November 1989.

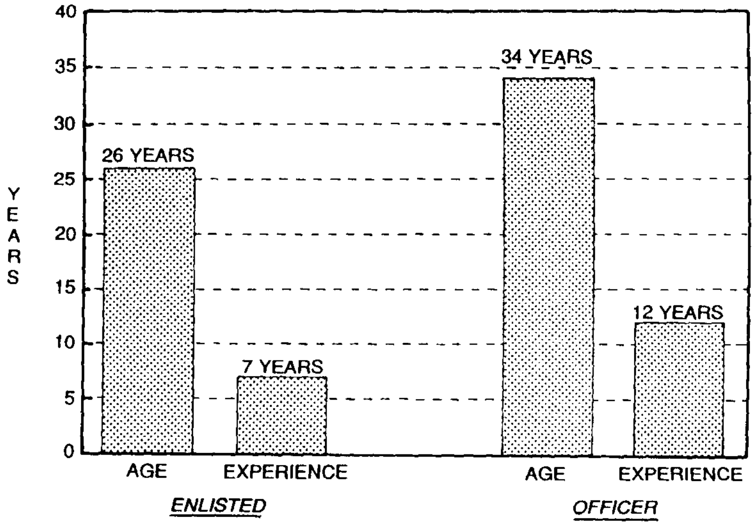
Figure 10. Air National Guard Maintenance Manpower Demographics

The manpower standard for the full-time maintenance organization authorizes approximately one-third of the positions of the part-time standard. As explained earlier, this full-time/part-time force structure is cost-effective, but its very nature limits the number of working hours and shifts with which maintenance can operate. The military air technician is governed by *US Code*, Title 32, *National Guard*, which puts the person in a noncompetitive civil service category subject to federal personnel regulations. He or she is required to retain qualification and to maintain affiliation with the assigned military organization in order to remain employed.

Each aircraft maintenance unit in the ANG is organized and functions under the provisions of this centralized concept and manpower standard while the Air Force aircraft maintenance units are organized and operate significantly differently, at least on the surface.

The USAF Combat-Oriented Maintenance Organization

The USAF currently consists of 244 flying squadrons that have a total of 5,481 combat aircraft distributed throughout the United States and overseas. There are almost 572,000 personnel in the Air Force today, approximately 20 percent of which are specifically assigned to aircraft maintenance.[19] The flying units are organized as three-squadron wings with 72 PAA. Each wing has an associated combat-oriented maintenance organization (COMO) that is operationally and administratively controlled by the wing and located at the same base. A look at the Air Force aircraft maintenance demographics reveals that the maintenance officer averages 34 years of age and 12 years of experience. The enlisted person, whose average age is 26, has 7 years of experience (fig. 11).[20]



Source: George Larry Jones, "Decentralization versus Centralization of the Aircraft Maintenance Management System within the Air National Guard" (Master's thesis, Central Michigan University, 1986), 24.

Figure 11. Air Force Maintenance Manpower Demographics

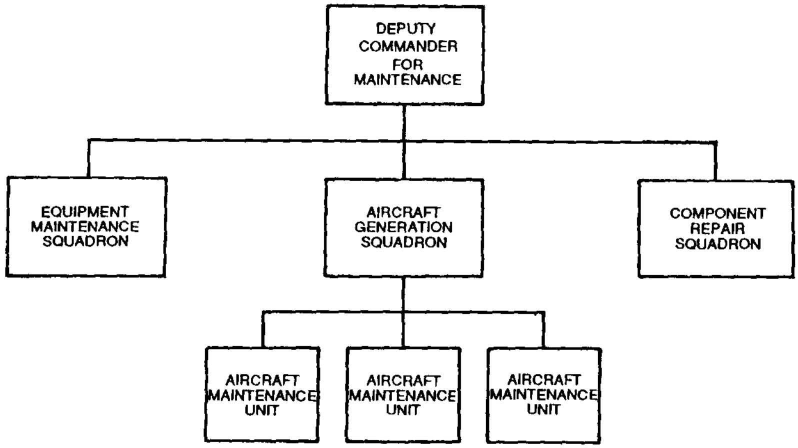
Ancillary and Rivet Workforce Training

Since the full complement of Air Force personnel is essentially available on a daily basis, the ancillary training and RWF cross-training requirements for the COMO can be accomplished over a large number of hours throughout the year. Although the training requirements are sizable, spreading them out over a longer period with more available hours has a negligible impact on primary skills training.

Organization and Operation

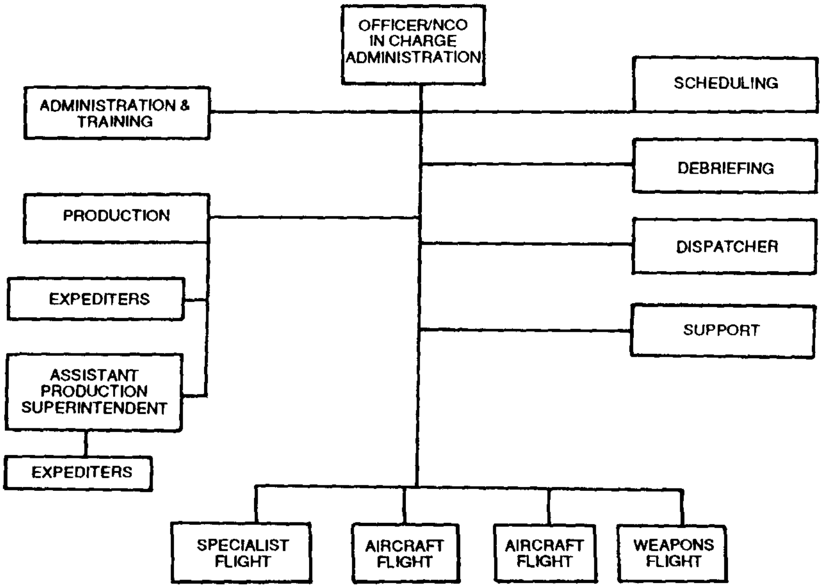
Along the continuum between centralization and decentralization that McLaren talks about, the Air Force maintenance organization falls closer to a decentralized structure than a functional one but is less decentralized than the self-contained structure. The COMO of the tactical air forces (TAF) closely approximates the description that Daft and Steers classify as a hybrid: "The hybrid structure contains elements of both functional and self-contained divisions, but a few functions are maintained as centralized functional departments."[21] The current structure of the TAF COMO is depicted in figure 12. The deputy commander for maintenance is the senior maintenance manager with a centralized staff that supports three maintenance squadrons, each having a squadron commander and each functionally grouped by the type of maintenance performance. The aircraft generation squadron (AGS) accomplishes on-aircraft (on-equipment) maintenance, while the component repair squadron (CRS) and the equipment maintenance squadron (EMS) accomplish off-aircraft (off-equipment) maintenance. The AGS is further subdivided into three aircraft maintenance units (AMU), each of which has all the necessary equipment and personnel to operate autonomously when deployed. The AMU is the linchpin of the COMO and is organized as shown in figure 13.[22]

To illustrate how the COMO operates, we can use the same typical scenario in which the pilot's radio becomes inoperative during flight. Upon landing, the pilot is debriefed on the flight line



Source: MCR 66-5.

Figure 12. Combat-Oriented Maintenance Organization of the TAF



Source: MCR 66-5, ix.

Figure 13. Aircraft Maintenance Unit

by the aircraft crew chief and system specialists assigned to the AMU. These specialists can then diagnose and repair or replace system components on the aircraft. The malfunction is entered on the aircraft forms, a job control number is assigned, and production control immediately identifies and directs the specialist to correct the problem.

In this situation, the Maintenance Operations Center (MOC), a coordinating function, is not involved in the decision-making process. The individual at the lowest level of the hierarchy who was at the scene and who knows exactly what the malfunction is makes the decision. There is very little time wasted in determining what has to be done to fix the airplane and put it back in service. If the radio were found to be inoperative, the specialist assigned to the AMU would replace it with another radio and send the faulty one to the "back shop" off the flight line in the component repair squadron for other assigned specialists to perform off-equipment maintenance on it.

The COMO structure shares the advantages and disadvantages of the functional and self-contained structures. Probably the biggest advantage, though, especially in the AGS, is the excellent coordination and communication within and between the divisions.

What's the Difference?

When compared to the ANG's specialized, centrally controlled maintenance concept, the COMO provides two major and radically different approaches to aircraft maintenance.

First, the decision-making process in the COMO is decentralized to the lowest feasible level, where the responsibility is assigned and the authority is delegated to those people in the unit who have the expertise and the facts to make the proper decision about any malfunction. The aircraft production control responsibility is located at the organizational level in the AMU. Flight-line specialists are also assigned to the AMU so production control has the authority to direct all on-equipment work.[23] The

ANG maintenance organization retains centralized control at the squadron level in the central body of maintenance control. Specialists are assigned to their respective shops within the appropriate maintenance branch and are dispatched by maintenance control to the aircraft needing maintenance.

Second, the COMO separates the on- and off-equipment functions. The AMU in the aircraft generation squadron performs only on-equipment maintenance while the "back shops" in the component repair squadron and equipment maintenance squadron perform off-equipment work. In the ANG centralized organization, all crew chiefs and other airplane general mechanics are assigned to the organizational maintenance branch, avionics specialists to the avionics maintenance branch, mechanical and heavy equipment specialists to the field maintenance branch, and all the munitions-related experts to the munitions maintenance branch. Theoretically, the aircraft belong to their crew chiefs while the other specialists perform maintenance on removed components or are dispatched to perform maintenance on the aircraft.

Ironically, ANG units do not operate under a centralized maintenance concept during certain situations, such as during deployments and sortie-surge exercises. Specialists are often prepositioned in mobile vans with equipment spares to quickly save a ground abort. During recovery, the same thing happens. Specialists are standing by on the flight line when aircraft return and are parked. Debriefing occurs at the aircraft, or in proximity to the flight line, between these specialists and the aircrews in order to minimize the time spent in putting the aircraft back into service.

During these same deployment periods and sortie-surge exercises, the ANG unit also might operate in an on-equipment mode, taking only remove-and-replace actions. A mission support kit (MSK), which consists of component spares extracted from a larger war readiness spares kit (WRSK) left at the home base, helps support sorties in those situations. Components that require repair are removed from the aircraft and either placed back in the MSK in an unserviceable condition to be returned on redeployment or

are ferried back to home base for repair, and a serviceable replacement component for the aircraft is returned.

These examples clearly demonstrate that under conditions that limit resources and require high sortie rates, the ANG maintenance units modify the centralized, on- and off-equipment method of operation and revert to one that approximates the COMO operation. Multicommand Regulation (MCR) 66-5, *Combat Oriented Maintenance Organization*, states that COMO "was designed to meet the particular combat operational needs of the TAF." [24] These needs are focused on high sortie rate production, which requires the timely launch, recovery, repair, and relaunch of combat sorties, especially during the sustainability phase of a war.

Another difference between the ANG organization and the COMO is the rate of implementation of Rivet Workforce and its effect on how the two organizations operate. The Air Force has instituted the program while the ANG is still in the process of implementing it. RWF's consolidation of skills reduces the total number of skill specialties required to support a weapon system. Some of the technicians who hold the newly designated aircraft maintenance AFSC will perform only on-equipment maintenance, but cross-utilization training will expand the scope of their responsibility to include other skills. Technicians with other AFSCs will perform the repair of system components only in the back shops and will likewise see their area of responsibility increased.

The final major difference between an Air Force maintenance organization and the ANG unit is size. It typically requires approximately three times as many people to support three 24-PAA squadrons of like mission, design, and series (MDS) versus one of the ANG; thus, there is a significant differential in size and complexity in the USAF structure. The typical Air Force F-16 wing has 1,642 people assigned within the maintenance organization, whereas an ANG F-16 wing has only 553.[25] The organizational theorists have noted that as organizations grow in size and complexity, the centralized or functional ones become

more cumbersome and inefficient. The tendency is to decentralize into smaller, more manageable units, which the Air Force chose to do when it changed from the AFM 66-1 centralized structure to the COMO structure.

In the ANG, the consolidated aircraft maintenance squadron is a downsized organization comparable to the Air Force wing maintenance structure, and the organizational maintenance branch is downsized and is comparable to the aircraft maintenance unit in the COMO, less the specialist and weapons flights. Although the ANG maintains essentially a centralized organization, it operates very much like the AMU under certain conditions (as mentioned earlier), but it does not have the duplication of skills found in the COMO.

In contrast to the active Air Force, a change in organizational structure in the ANG could have a major impact on the full-time and part-time force and could lead to substantial increases in manpower and cost.

Notes

1. David A. Nadler et al., *Managing Organizations* (Boston: Little, Brown and Co., 1982), 312.

2. Robert I. McLaren, *Organizational Dilemmas* (New York: John Wiley and Sons, Inc., 1982), 8–13.

3. Richard L. Daft and Richard M. Steers, *Organizations: A Micro-Macro Approach* (Glenview, Ill.: Scott, Foresman and Co., 1986), 366–67.

4. Ibid.

5. Ibid., 368–69.

6. Ibid.

7. Ibid., 369.

8. Ibid.

9. Ibid.

10. Ibid., 370–73.

11. Ibid., 374.

12. Ibid.

13. Ibid.

14. National Guard Bureau, *Chief, National Guard Bureau Annual Review: Fiscal Year 1988*, report to the secretaries of the Army and Air Force (Washington, D.C.: National Guard Bureau, 1989), 12.

15. The amount of hours available to the traditional Guard member normally is based on two days of inactive duty training per month and 15 days of active duty training per year.

16. The 277 hours per year estimate for ancillary training requirements was taken from the minutes of the ANG Maintenance Council's meeting, ANGSC/LGM, Andrews AFB, Md., 12–13 July 1989.

17. Bob Baggstrom, Air National Guard Support Center/8200 MES, telephone interview with author, 22 November 1989.

18. Mary Phillips, Air National Guard Support Center/DPD, telephone interview with author, 21 November 1989.

19. "An Air Force Almanac: US Air Force Personnel Strength—1907 through 1990," *Air Force Magazine*, May 1989, 45.

20. George Larry Jones, "Decentralization versus Centralization of the Aircraft Maintenance Management System within the Air National Guard" (master's thesis, Central Michigan University), 24. The ages and years of experience shown for the Air Force officer and enlisted maintenance person are approximate, since their purpose is only to show the relative differences in age and experience levels of ANG and USAF maintenance personnel.

21. Daft and Steers, 376.

22. Multicommand Regulation (MCR) 66-5, *Combat Oriented Maintenance Organization*, 31 May 1985.

23. Ibid.

24. Ibid.

25. Steve Mills, Headquarters TAC/XPMS, and Bob Baggstrom, Air National Guard Support Center/8200 MES, telephone interviews with author, 15 and 22 November 1989, respectively. The Air Force figure is the number of maintenance personnel in a three-squadron wing versus the ANG figure for a one-squadron wing.

Chapter 3

Analysis and Assessment

Chapter 2 examined and compared the organizational and operational differences and similarities of the ANG centralized maintenance organization and the Air Force decentralized organization. In order to properly evaluate these two different types of organizations, we must consider another dimension within the boundaries of the organizational structure variable. The subjective evaluation of ANG and active Air Force organizational structure and operation becomes more cogent when there is a quantitative assessment of the changes required to mirror the organization of the gaining command. What are the economic costs in terms of increased manpower, training, and salaries? What are the potential organizational and operational benefits of each? Answers to these questions, complemented by the comparison in chapter 2, will help us make a value judgment about the two different organizations.

During the force buildup in Southeast Asia in 1964, it became apparent that weaknesses existed in the organizational structure of the Air Force's tactical fighter wings. The Air Force Scientific Advisory Board was tasked later that year to identify the problems and to propose solutions. Out of this came the Tactical Air Capability Task Force, an element of which was a logistics working group. The conclusions reached in 1965 support the following statement in a Rand study about predeployment planning lessons learned:

> Combat organizations should be structured to minimize the difference in organization and operating procedures between a peacetime training mode and a deployed combat posture.[1]

Although its conclusions supported this statement, the report did not address the major question of how much restructuring would cost.

Tactical Air Command (TAC) was directed by Headquarters USAF to study the problem further after most of the conclusions of the Scientific Advisory Board were accepted. The TAC enhancement study that followed examined a variety of possible tactical fighter wing organizational postures at different levels of combat activity with the objective of placing a price on each type. One of the findings of this study was that "the cost of structuring a force with significant independent squadron deployment capability would be substantial, but not unacceptably so."[2] The bulk of the increased cost was accounted for in the areas of additional people, field maintenance equipment, war readiness spares, motor vehicles, and mobile facilities. This study addresses the cost implications of only the potential additional manpower requirements to restructure the ANG maintenance organization.

Monetary Costs

When we recognize the fact that restructuring to mirror the gaining command's organization would result in additional people, two questions immediately come to mind. First, how many additional people would be required? Second, what are the organizational, economic, and operational costs versus benefits derived?

To help answer the first question about additional personnel requirements, table 1 shows the differences between the peacetime manpower requirements of selected ANG flying units with centralized management and like Air Force flying units with decentralized management.[3] The ANG flying units are TAF fighter units that are gained by TAC. They are all one-squadron wings with 24 primary authorized aircraft and a consolidated aircraft maintenance squadron, whereas the Air Force units are three-squadron wings with a COMO. Manpower requirements of the Guard's consolidated aircraft maintenance squadrons are

compared to one-third of the Air Force wing maintenance manpower requirements since 1:3 is the approximate ratio of the total number of aircraft maintenance personnel in the ANG to those in the Air Force. The percentage difference in personnel of each TAF unit is computed and the average percent increase derived from that data. The anticipated overall increase of 10.9 percent in manpower is applied across the Guard's TAF maintenance community of approximately 12,216 personnel, which equates to a need for 1,099 additional people that the ANG would have to acquire, train, and pay.[4] AFR 173-13, *US Air Force Cost and Planning Factors*, October 1989, estimates the costs of acquiring, training, and paying Air Force military personnel.

TABLE 1

Peacetime Maintenance Manpower Comparisons

ANG Centralized (Functional) versus Air Force Decentralized (Hybrid)

Mission Design Series	*PAA*	*No. of ANG CAMS Personnel*	*No. of AF Wing Personnel*	*Percent Difference*
F-4	24	563	499	11.4
A-10	24	396	539	26.5
F-15	24	567	539	4.9
F-16	24	553	547	1.1
				Average 10.9

Source: Mary Phillips, ANG Support Center/DPD, telephone interview with author, 21 November 1989.

Acquisition Costs

Counting both fixed and variable costs, the typical average cost to acquire and train a basic recruit in fiscal year 1989 was $7,178. The costs for acquisition include recruiting, initial travel and clothing, and basic military training at the Air Force Military Training Center. The costs do not include technical skills training to attain an Air Force specialty code (AFSC).[5]

Basic Skill Level Training Costs

Technical skills training cost factors are based on variable costs only and include cost per graduate to attain a specific AFSC at the basic skill level, acquisition costs, basic pay and allowances, permanent change of station (PCS) costs, and pay and allowances for accrued leave. This cost is typical of a no-prior-service individual who is recruited into an ANG unit, sent off to basic military training (BMT), and then to formal technical training. The enlisted member acquisition costs per aircraft maintenance graduate by Air Force specialty code are listed in table 2.[6]

Total Acquisition and Training Costs

The cost for the ANG to acquire each additional person is dependent on whether the individual has had prior military service. For each no-prior-service inductee, the cost to acquire and train the individual to the basic skill level is $17,336.[7] No-prior-service personnel comprise approximately 37 percent of the total annual acquisition of personnel; therefore, the total training cost to the ANG for these people is the total number of additional new recruits multiplied by the percentage of no-prior-service accession multiplied by the composite average cost to acquire and train each one. For each prior-service acquisition, the composite average cost is equal to the acquisition cost less the cost of BMT, or approximately equivalent to the recruiting cost of $4,457. Likewise, the total cost for a prior-service inductee is computed at

approximately 63 percent of accessions. Table 3 depicts the computations and results.[8]

TABLE 2

Costs per Graduate by AFSC (Fiscal Year 1989)

AFSC	*Cost*	*AFSC*	*Cost*
30231	$16,697	40431	$16,964
32130	23,837	42330	14,454
32131	22,805	42331	14,250
32132	24,000	42332	10,584
32232	23,450	42333	10,411
32430	25,254	42334	11,922
32530	21,578	42335	15,766
32531	20,526	42632	11,238
32630	28,412	42730	33,107
32633	28,882	42731	9,446
32634	29,624	42732	12,487
32635	26,745	42733	13,305
32636	9,968	42734	13,275
32637	10,452	42735	12,160
32638	10,181	43130	12,616
32830	21,804	43131	9,913
32831	23,477	46130	12,794
32833	29,622	46230	13,457
32834	23,847	46430	34,219
32835	22,707		
39130	12,912		
39230	12,376		

Source: AFR 173-13, *US Air Force Cost and Planning Factors*, 31 October 1989.

TABLE 3

Total Monetary Costs: Acquisition and Training

Category of Recruit	*Basic Skill Level Training*	*Percentage of Acquisitions*	*Additional Manpower @ 9 Percent*	*Total Cost to ANG**
No Prior Service	$17,336	37	1,099	$7,049,338
Prior Service	$4,457	63	1,099	$3,085,893
Total	$21,793	100	1,099	$10,135,231

*Constant fiscal year 1989 dollars.

Source: Robert Mertens, NGB/DRR, telephone interview with author, 20 November 1989.

Pay and Allowance Costs

Once the additional personnel acquisitions are made and paid for, the recurring expense of military and civilian pay and allowances must be considered. At this point a differentiation must be made between military and civilian pay. The reference to military in the ANG includes the traditional Guard members and the full-time *US Code*, Title 32, employees when in military status. Since the full-time force comprises 27 percent of the ANG and the part-time force 73 percent, we may logically assume that the increases in manpower to convert to a decentralized structure will reflect proportional increases in each part of the force.[9] Using the previously computed percentage increase in manpower of 9 percent, the full-time force would increase by 27 percent of 1,099

people for a total of 297 and the part-time force would increase by 73 percent of 1,099 people for a total of 802.

The average salary of a full-time military technician in fiscal year 1989 was $34,119, including benefits, while the average salary of the part-time Guard member was $4,097. These figures are based on the performance of 48 unit training assemblies (UTA) and 15 days of annual field training (AFT), including benefits.[10] The total recurring annual costs required to provide pay and allowances for the additional people in fiscal year 1989 dollars is estimated to be $13,419,137, as reflected in table 4.

TABLE 4

Total Monetary Costs: Pay and Allowances

Type of Employee	*Increased Manpower Required*	*Average Salary per Person per Year*	*Total Cost per Year to ANG**
Part-time Guardsman	802	$4,097	$3,285,794
Full-time Technician	297	$34,119	$10,133,343
Total	1,099	$38,216	$13,419,137

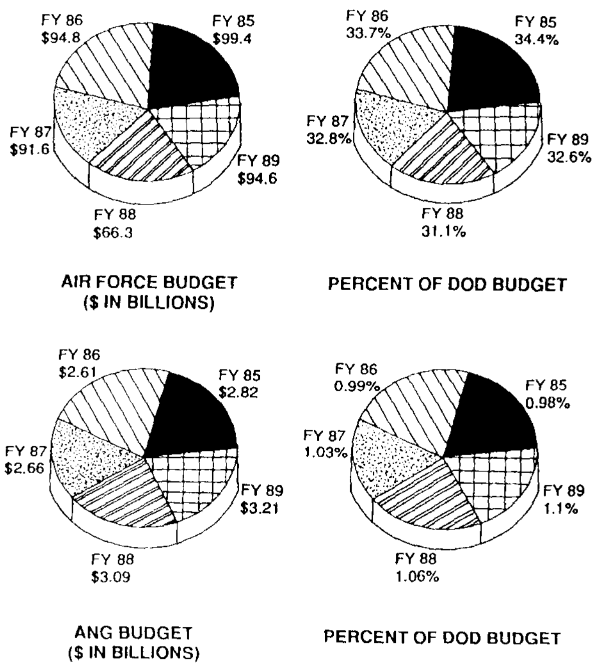
*Constant fiscal year 1989 dollars.

Source: Michael E. Dubeau, NGB, telephone interview with author, 30 November 1989.

These costs do not represent expenditures for a particular year. They would have to be considered as life-cycle costs; that is, costs over the length of time that it would take to acquire and train the 1,099 additional people at 1989 dollars.

Overall Operating Costs

The part-time nature of the ANG force allows certain tasks to be performed and combat readiness to be maintained at a reduced cost over that of a full-time armed force. Such cost savings can be perpetuated as long as missions assigned to the ANG can be performed by a part-time force. These cost savings are reflected in the appropriations for the ANG and the active Air Force over the past five fiscal years.[11] Figure 14 portrays the differences in the cost to the Department of Defense in terms of percentage of budget authority (BA) to operate the ANG and the Air Force. Although it is funded at only 1 percent of the DOD budget authority, the ANG provides a significant portion of the overall aviation capability of the US Air Force, as shown in table 5.[12]



Source: "An Air Force Almanac: The United States Air Force in Facts and Figures," *Air Force Magazine*, May 1989, 51.

Figure 14. Percentage of DOD Budget Authority—Air Force and Air National Guard

TABLE 5

ANG Aviation Contribution to USAF Capability

Tactical Fighters	25%
Air Defense Interceptors	86%
Tactical Reconnaissance	50%
Tactical Air Support	36%
Strategic Airlift	5%
Tactical Airlift	34%
Air Refueling	18%

Source: *Air Force Magazine*, May 1989, 52.

Nonmonetary Costs and Benefits

We have seen that mirroring the gaining command organizationally would require manpower increases. This larger pool of maintenance personnel would also create an increased demand for training, both technical skills training and on-the-job training (OJT). For at least the last five years, the ANG has been allocated over 400,000 flying hours per year.[13] These flying hours are based on the training needs of aircrews and the maintenance personnel since every flight generates some form of aircraft maintenance activity. Although the increased number of maintenance personnel would increase training demands, it is unlikely that the flying hour allocation would also be increased; consequently, there would be no increased maintenance activity. It follows, then, that the maintenance requirements would remain constant and would be accomplished by more people, allowing less actual hands-on training to be conducted. The impact on the quality of maintenance could be significant.

With the implementation of Rivet Workforce in the ANG, the training benefits of reorganizing to mirror the gaining command could also be significant. Since the maintenance concept would be changed to the performance of on- and off-equipment tasks, the training work load would eventually be less. There would be no requirement to be proficient in both on- and off-equipment maintenance any longer, thereby reducing the overall practical training work load. The realization of reliability and maintainability initiatives would reinforce the trend toward a reduced training work load, further counterbalancing the effects of the increased manpower.

A reorganization to the COMO would require a sacrifice in efficiency and economy of scale. The decentralization of our maintenance work force to an on- and off-equipment concept results in duplication of some resources. The specialists who perform on-aircraft maintenance in AGS might find themselves idle during any particular time of the day because aircraft are flying and other aircraft have no problems within their field of expertise that have to be corrected before the next flight. However, their counterparts performing off-equipment maintenance in the back shop might have several days' backlog of line replaceable units to repair and test. On the other hand, the ANG technician specialists would return to their shop after aircraft are launched and supplement the work of their counterparts while waiting for aircraft to return from flight.

Decision Making

Decentralized maintenance enables maintenance personnel to make speedy decisions about the condition of an aircraft. Aircraft discrepancies no longer have to be up-channeled to maintenance control to await a decision about who is responsible to correct them or when they should be corrected. That decision is made at the lowest possible level in the aircraft generation squadron where the system specialist is assigned and located directly on the flight line. The need for repeated or redundant communications between the

flight line, maintenance control, and the specialist shops is eliminated along with the time it would take specialists in a centralized organization to get their tools and report to the flight line.

Sortie Production

The combat-oriented maintenance organization provides the capability to make speedy decisions about aircraft condition and repairs with the objective of meeting combat operational needs. The focus is on high sortie production, which requires timely launch of initial combat sorties and subsequent rapid recovery, repair, and relaunch of aircraft. Although this concept has not been proved in combat, where sustained flying operations are necessary, simulations have validated its effectiveness.

For example, the first such exercise, Coronet Warrior, was conducted by TAC in August 1987 to validate and improve the Dyna-Metric computer model used to evaluate the readiness of combat units. Coronet Warrior was a 30-day flying exercise involving the 94th Tactical Fighter Squadron at Langley AFB, Virginia. Wartime conditions were simulated by isolating the flying unit at home station in a simulated deployed environment. Only those people, spares, and equipment authorized in the unit's aviation package unit type code (UTC) were involved. The 24-PAA unit flew at the designed operational capability sortie rate for 30 consecutive days. At the end of the exercise, comparisons of actual-versus-predicted performance indicated that the unit actually flew 98 percent of its tasked sorties versus the predicted 91 percent and was able to maintain 17 aircraft fully mission capable (FMC) at the end of the 30 days versus the four predicted.[14] Under the simulated wartime conditions of Coronet Warrior, COMO seems to have met its objectives; however, there is no hard evidence to determine its benefits under actual combat conditions.

When considering the sortie-production benefits under centralized maintenance, there is some actual combat experience that can be drawn upon to assess its capability. Four ANG fighter

squadrons were mobilized in 1968 to deploy to the Republic of Vietnam (RVN) for one year. During that time these units flew 30,000 sorties for a total of 50,000 flying hours, a noteworthy accomplishment.[15] Active Air Force units were also under centralized maintenance at that time, so there is no real basis for comparing the actual wartime benefits of the centralized organization versus the decentralized one. There is only the peacetime performance during sortie-surge exercises, deployments, and combat simulations—all of which indicate the high sortie production expected to meet combat operational needs—to use as the basis for determining the capability of the COMO.

Flexibility

The manpower demographics depicted in figures 10 and 11 in chapter 2 reveal a more mature and technically qualified ANG force as compared to the active force. The enhanced skill, expertise, experience, and job knowledge of the ANG provide the maintenance manager much flexibility. Under the centralized maintenance organization, the technician is required to perform both on- and off-equipment maintenance. He or she can diagnose problems, perform repair actions on the aircraft, and then return to the shop to perform repair actions on components.

The experience level and the flexibility of its force raise the value of the ANG to the Air Force when mobilization occurs. The active duty unit to which the Guard member is assigned can utilize him or her on the flight line or in the back shop, wherever the skills are most needed.

Over the five-year period FY 1984–FY 1988, the number of aircraft, flying hours, and personnel increased. The number of ANG aircraft increased by .48 percent per year (from 1,688 to 1,730); total flying hours increased by 1.36 percent per year (to 29,000);[16] and the number of ANG personnel by 1.8 percent per year (to 10,000).[17]

The average increase in personnel that occurred during fiscal years 1984–88 would have to be doubled to 3.6 percent per year

over the next five years to accommodate the additional manpower requirements identified in this study to restructure the ANG tactical air forces alone. If the additional people were to be realized, the number of available man-hours assigned would increase correspondingly as would the capability to fly more hours, which would increase the need for more aircrews, and so on.

Severe budget reductions, coupled with a widespread perception of reduced threat to our national security, will more than likely create an austere environment where little, if any, growth will occur over the next half decade. It is with this prospect in mind that I propose a structure of a modern ANG maintenance organization for the 1990s that will have to continue to function efficiently and effectively within this changing environment.

Notes

1. James R. Hickey, "Logistics Lessons Learned from the Vietnamese Era," in *The Logistics of Waging War* (Gunter AFS, Ala.: Air Force Logistics Management Center, 1986), 161.

2. Ibid.

3. Steve Mills, Headquarters TAC/XPMS, and Bob Baggstrom, Air National Guard Support Center/8200 MES, telephone interviews with author, 15 and 22 November 1989, respectively.

4. Mary Phillips, Air National Guard Support Center/DPD, telephone interview with author, 21 November 1989.

5. AFR 173-13, *US Air Force Cost and Planning Factors*, 31 October 1989, 14.

6. Ibid., 29–30.

7. Ibid., 32–33. The average cost to train one recruit was computed by totaling all the costs of the Air Force specialty codes listed and dividing by the total number of 41.

8. Robert Mertens, National Guard Bureau/DRR, telephone interview with author, 20 November 1989. Basic skill-level training costs for no-prior-service personnel include recruiting and BMT costs. For prior-service personnel, costs shown are recruiting costs only.

9. National Guard Bureau, *Chief, National Guard Bureau Annual Review: Fiscal Year 1988*, report to the secretaries of the Army and Air Force (Washington, D.C.: National Guard Bureau, 1989), 103–5.

10. Andrew Zeck, National Guard Bureau, Office of the Comptroller/AC, telephone interview with author, 17 November 1989.

11. Michael E. Dubeau, National Guard Bureau, Office of the Comptroller/ACB, telephone interview with author, 30 November 1989.

12. "An Air Force Almanac: The United States Air Force in Facts and Figures," *Air Force Magazine*, May 1989, 51.

13. Zeck interview.

14. Donald C. Pipp, "Coronet Warrior—A WRSK Flyout," *Air Force Journal of Logistics*, Summer 1988, 1–4.

15. *National Guard Almanac 1989* (Falls Church, Va.: Uniformed Services Almanac, Inc., 1989).

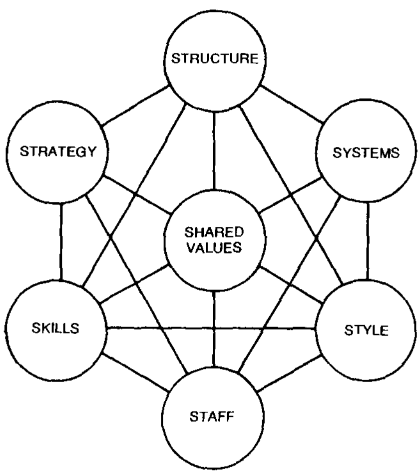
16. "An Air Force Almanac," 54. Percentages shown were derived from computation.

17. Ibid., 53. Percentages shown were derived from computation.

Chapter 4

Restructured Air National Guard Combat Organization

According to the theories of the organizational behaviorists and research results of management consultants like Thomas J. Peters and Robert H. Waterman, Jr., there are other interdependent variables that affect the functioning and structure of the organization besides its wiring diagram. The effects of these other variables must be considered before envisioning what the future ANG maintenance organization should look like. In their book *In Search of Excellence*, Peters and Waterman defined these interdependent variables in terms of what they called the McKinsey 7-S Framework (fig. 15).[1] Harold Leavitt similarly



Source: Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence: Lessons from America's Best-Run Companies* (New York: Harper and Row Pubs., Inc., 1982), 10.

Figure 15. The McKinsey 7-S Framework

defined the multivariable framework as "Leavitt's Diamond," which encompasses task, structure, information and control, and environment.[2] Both of these conceptual frameworks help to encourage thinking about the hardware (strategy and structure) of an organization as well as the software: style, systems, staff (people), skills, and shared values (culture).[3] The organizational structure, therefore, is only one variable in the total framework, the fluidity of which makes it imperative that the organizational structure be flexible enough to respond continually to any sort of change in the environment.

What, then, should be the structural form of the Air National Guard TAF maintenance organization in the 1990s? Should the organization be modified to mirror the active gaining-command structure? In the process of further addressing these questions, this study assesses the effects that certain major factors are likely to have on the future Air Guard maintenance structure.

Force Structure and Equipment

The perception of a diminishing threat to our national security and the prospect of dwindling budgets will certainly change the active/reserve force mix. As the active services withdraw forces from Europe and Asia and draw down units and equipment, the ANG force structure is not likely to change. This should mean assumption of additional missions appropriate to the part-time nature of the ANG, missions that are no longer cost-effective for the Air Force. The change in the force mix will entail reorganization, activating some units and strengthening others. For example, the Air National Guard has experienced a 42-percent mission conversion rate of units over the past five years and is expected to convert or reorganize at a rate of an additional 34 percent of our units over the next five years.[4]

Concurrently, the planned continual modernization of ANG units from older aircraft and equipment to newer, more modern types will likewise necessitate the restructuring of our organizations. The number of man-hours per flying hour required

to maintain older weapon systems such as the F-4, A-7, and OA-37 is substantially larger than what is required to maintain newer systems such as the F-16, A-10, and F-15. This modernization translates into fewer personnel requirements and a different organizational structure.

Management and Leadership Initiatives

Perhaps the most dramatic example of the effect that management and leadership style has had on organizational structure is the set of initiatives that Gen W. L. Creech instituted in the Tactical Air Command (TAC) during his tenure as commander in the late 1970s to mid-1980s. Although these were wide-ranging and multifaceted initiatives that permeated the entire organization, this study addresses only the maintenance and supply initiatives and their effect on the organization. During the decade of the 1970s, TAC experienced a steady decline in sortie productivity, combat capability, and morale with a resultant decrease in pilot proficiency and readiness.[5] Aircraft maintenance was centralized at the time and was characterized as follows:

- Wing resources were directed at producing wing sorties.
- There was no tie between operations and maintenance below the wing planning and coordination level.
- The control of all specialists, "back shop" personnel, and plans and scheduling was at wing level.
- Any wing pilot flew any wing aircraft.
- Any crew chief and any specialist worked on any aircraft.
- Only the crew chiefs were on the flight line; all others were behind/off the flight line.
- There were lots of coordination and paperwork—lots of clerks.
- Statistics were aggregated by the wing; the strong carried the weak.
- The flying squadron had to be "assembled" from various parts to go to work.[6]

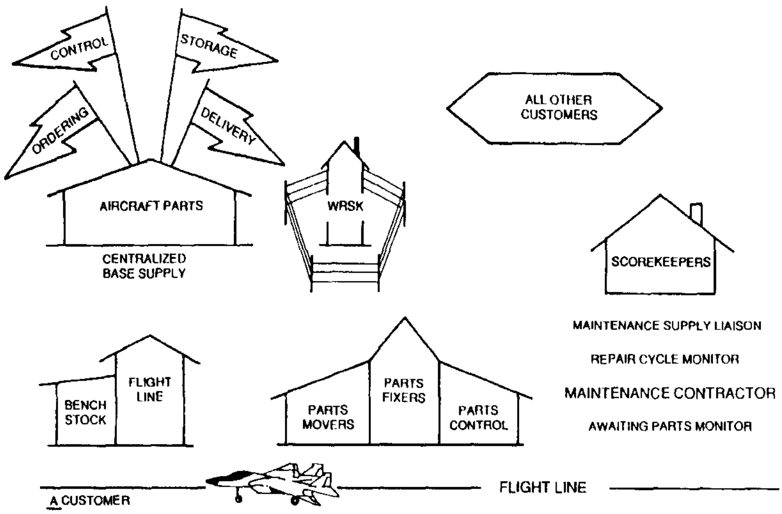
The approach that was initiated to reverse the negative trend was a fundamental change in maintenance management philosophy with concurrent structural change. The change to a combat-oriented maintenance organization structure reflected the change in philosophy and resulted in a complete reorganization of maintenance from a centralized, vertical structure to a decentralized, somewhat flatter structure. The key tenets of the COMO philosophy can be summed up as follows:

- Focus on self-sufficient squadrons.
- Organize and train as we intend to fight.
- Assign responsibility and delegate authority to the lowest feasible level—trust the troops.
- Get specialists and NCOs of all skills back on the flight line.[7]

Closely associated with the initiative in the aircraft maintenance organization was a follow-on initiative that affected the supply organization structure primarily. The inseparable nature of maintenance and supply necessitated some variations in the supply structure to complement those which the maintenance organization made. Likewise, changes were made in maintenance to accommodate supply.

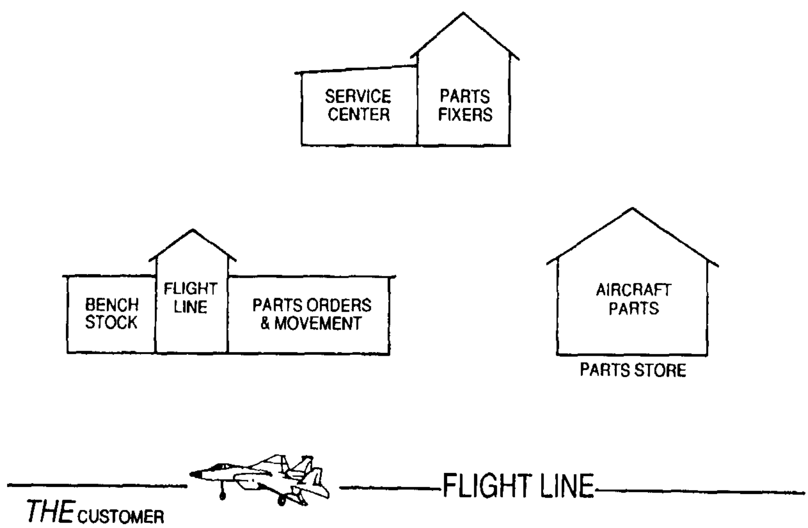
Like maintenance, supply had previously been highly centralized. All the aircraft parts, equipment, tools, and supply personnel were located in one central base supply area away from the flight line—in some cases, considerable distances. The aircraft was just *one* supply customer and fit into the overall organizational picture as shown in figure 16. After TAC decentralized supply, the aircraft became *the* customer instead of just another customer and the organization took on the appearance shown in figure 17.[8]

The high degree of centralization required a large number of people to perform each supply transaction with numerous scorekeepers.[9] For example, if a needed part could be repaired with bits and pieces, it took 43 steps, 243 entries on 13 forms, 22 people, and 16 hours of administrative and records-keeping time. The typical flow in repairing and returning a reparable part is shown in figure 18.[10] With the decentralization of the supply organization



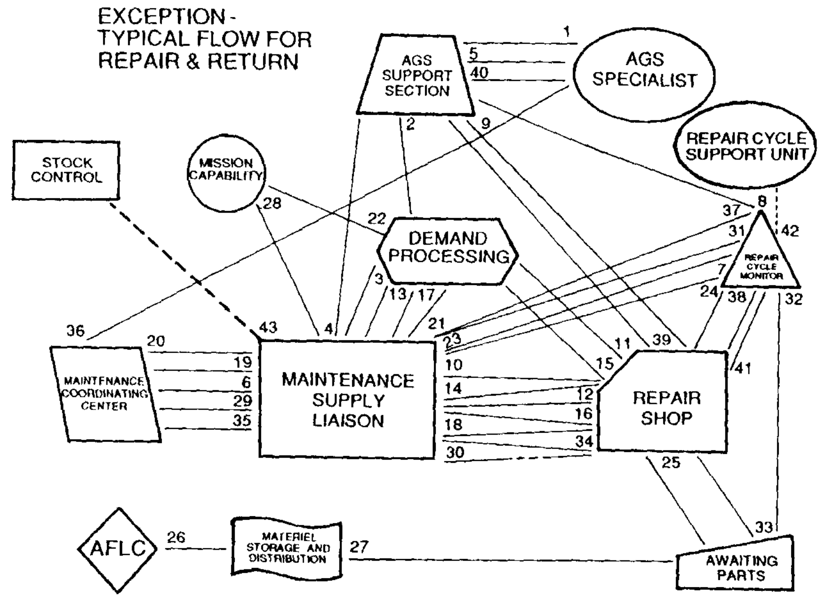
Source: Briefing, Lt Gen Henry Viccellio, Jr., subject: Senior Leaders Maintenance Course, Langley AFB, Va., May 1989.

Figure 16. Centralized Supply



Source: Viccellio briefing.

Figure 17. COSO Aircraft Parts

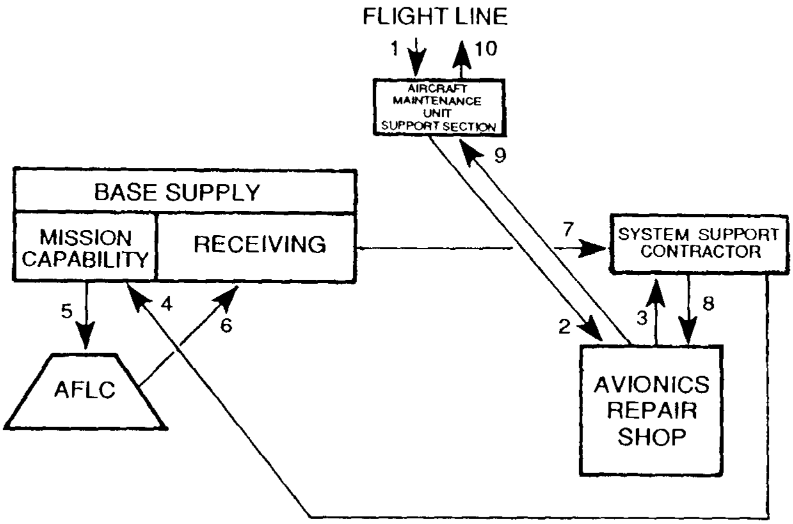


Source: Viccellio briefing.

Figure 18. The Common View

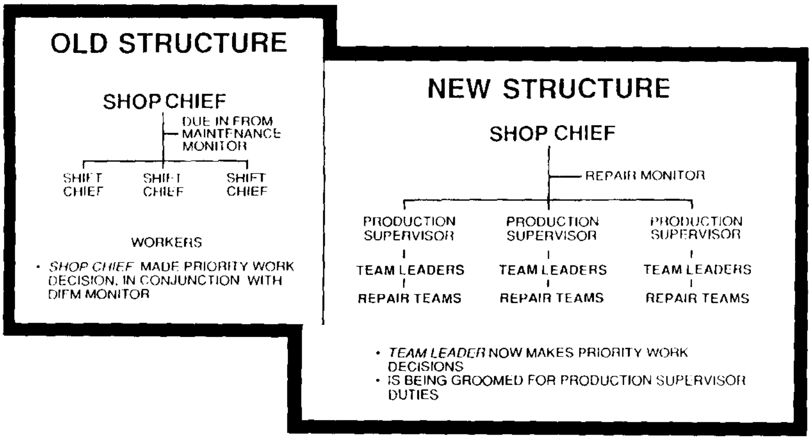
under the combat-oriented supply organization (COSO), if a part can be repaired with assorted items on hand, the reparable asset flow now takes 10 basic steps, reduced entries on 12 forms, 10 people, and an expedited response as shown in figure 19.[11]

Other organizational changes in the maintenance structure resulted from the implementation of COSO. The reparable asset management structure was changed within the avionics shop. The old centralized structure required the shop chief to make priority work decisions. The new structure decentralized the decision making to a team leader who has developed leadership skills necessary for supervisory duties, which makes the whole reparable process more efficient and effective. Figure 20 shows how the avionics shop was reshaped from a centralized to a decentralized structure.[12]



Source: Viccellio briefing.

Figure 19. Reparable Asset Flow



Source: Viccellio briefing.

Figure 20. Avionics Shop Reorganization

Alternative Maintenance Concepts

At the periodic meeting of Corona Fall 89, the Air Force senior leadership decided to implement a field-level test to determine alternative maintenance concepts that might feasibly meet Air Force support structure needs in the future. About a dozen factors specified in figure 21 were developed as considerations to provide guidance and direction for the tests. Many of these factors have a bearing on a potential organizational structure that could be quite different from what we have today. From a macroperspective, in accordance with AFR 66-14, we currently have three levels of maintenance (fig. 22): organizational maintenance, intermediate-level maintenance, and depot maintenance. Organizational maintenance and intermediate-level maintenance are performed by the unit for the unit at each base; and depot maintenance is performed by AFLC/contract for systems at the Air Logistics Center (ALC), at the contractor facility, or by depot field teams at various locations. The figure indicates the types of maintenance generally performed at each level.[13]

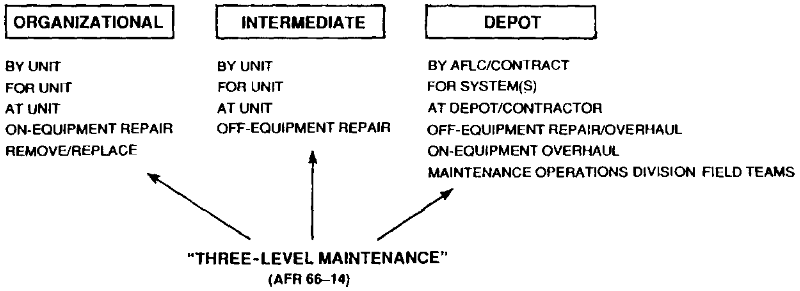
The proposed change to the current structure reflects a flexible maintenance concept that will essentially eliminate the intermediate level of maintenance as we know it today (fig. 23).

- FORCE COMPOSITION/SIZE
- OPERATIONS TEMPO
- DEPLOYMENT REQUIREMENTS
- EMPLOYMENT SCENARIO
- PRODUCTIVITY
- SKILL MIX
- RELIABILITY
- MAINTAINABILITY
- SURVIVABILITY
- TRANSPORTATION CAPABILITY
- PIPELINES
- SUPPORT EQUIPMENT

- GOAL: MAINTAIN PEACETIME READINESS AND WARTIME EFFECTIVENESS AT THE LOWEST *PRACTICAL* COST

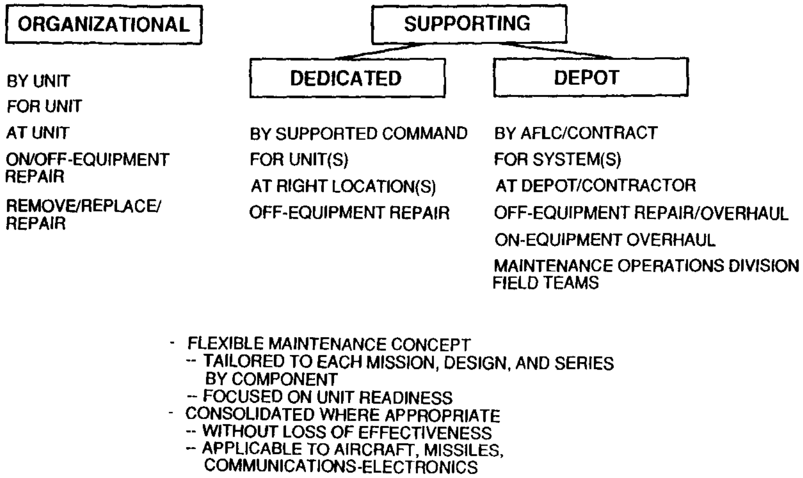
Source: Briefing, Lt Gen Henry Viccellio, Jr., subject: Combat Support and the Air Force Logistics Conflict of Operations, Air War College, Maxwell AFB, Ala., March 1990.

Figure 21. Factors for Consideration



Source: Viccellio 1990 briefing.

Figure 22. Current Concepts



Source: Viccellio 1990 briefing.

Figure 23. Proposal for Change

The new structure would have an organizational level of maintenance performed at the unit, by unit personnel, for the unit. However, both on- and off-equipment maintenance and an increased emphasis on repair would be placed at the organizational level. Instead of retaining an intermediate level of maintenance at each base, a supporting level would be formed consisting of dedicated and depot sublevels. The supported command would perform the supporting level of maintenance for designated units at locations for best support. Because current-generation aircraft with varying manpower and materiel needs will be the backbone of our fleet for years to come, the dedicated support structure would have to be tailored to each mission design series by component and would be consolidated only where it makes the most sense in terms of combat-support effectiveness.[14]

Defense Management Review

To date, the Defense Management Review (DMR) is probably the highest-level, widest-ranging management and leadership initiative that will affect organization and structure in the future. It was initiated by President George Bush in his February 1989 address to the joint session of Congress when he announced that he was directing the secretary of defense to "develop a plan to accomplish full implementation of the recommendations of the Packard Commission and to realize substantial improvements . . . in defense management overall."[15]

Among the other actions identified by the president to be taken to achieve the stated purpose of DMR was the improvement in the broad area of personnel and organization. The review included an examination of some of the largest successful private corporations in order to gain insight into the experience of the private sector in relation to comparable problems facing DOD. Some of the factors examined were management structures, staffing levels, impediments to decision making, stifled innovation, obscured accountability for success and failure, and excessive overhead

costs. The actions taken by these corporations to overcome problems demonstrated the usefulness of

- identifying and eliminating unnecessary functions and management layers;
- concentrating on core functions performed at appropriate organizational levels;
- consolidating related functions where doing so will occasion greater effectiveness or efficiency;
- lowering overall costs, particularly through sizeable reductions in management and other white collar personnel; and
- employing a variety of innovative techniques proven to motivate employees and suppliers and to achieve steady improvements in quality and overall performance.[16]

Although the main thrust of DMR is related to the defense acquisition system, the lessons learned from the corporate review of organizational "hardware" and "software" [17] teach that it is possible to achieve maximum efficiency over the long term and that "this should be a paramount objective of *all* . . . who play a role in U.S. defense efforts." [18] The key to overall efficiency is the small efficiencies realized at each management level from the bottom of our hierarchy to the top. This will involve structural changes (hardware) as well as changes in the other organization variables (software), all of which take time to evolve.

Total Quality Management

Total quality management (TQM) is a philosophy as well as a set of principles that form the pillars of a continuously improving organization. TQM did not receive much emphasis when first applied in DOD in the early 1980s. Its use expanded rapidly after the Office of the Assistant Secretary of Defense for Production and Logistics—OASD (P&L)—announced its support. Today it is one of DOD's primary initiatives for future change.[19] TQM is one of the stated purposes of DMR because it is expected to lower the cost of doing business while continuously improving quality in

products and process. In his article "The Quality Professional's Role in the New Economic Age," Edward M. Baker reiterates W. Edwards Deming's new set of principles for operating in the "new economic age": The enterprise of the 1990s has to develop the capability to

- simultaneously maintain consistent, repeatable production processes to prevent change.
- continually transform its processes, systems, and structures to take competitive advantage of ever-diminishing periods of environment stability.[20]

Baker asserts that extinction is the fate of those highly specialized organisms in nature that do not change when their purpose and environment change. He says that "the successful enterprise will develop a capability . . . to manage its own change without throwing itself into a state of chaos."[21]

The vertically structured, functionally oriented organization is rigid, presents obstacles to quality, and inhibits the process of change.[22] In conjunction with the rigidity of the organizational structure, consider the meaning of the oft-quoted phrase, "If it ain't broke, don't fix it." The implication is that change for change's sake is not justification for reorganization. I agree with this implicit meaning; however, another implication of this phrase is that there is resistance or even unwillingness to change despite the changing internal and external environment. Baker suggests that the future quality professional will think, believe, and act as if managing means maintaining a balance between preventing change and creating positive change. He says that management should be structured to anticipate and meet changing environments and new situations rather than to apply mechanistic and rigid management principles for control and avoidance of change.[23]

Reliability and Maintainability

In 1984, the USAF Reliability and Maintainability (R&M) 2000 Program was initiated by a joint Air Force chief of staff/secretary of the Air Force memorandum to all major air commanders that

institutionalized a commitment to reliability and maintainability. To achieve the objectives of the program, it developed five goals that were underlying factors of the overall R&M policy of "Double-R/Half-M": [24]

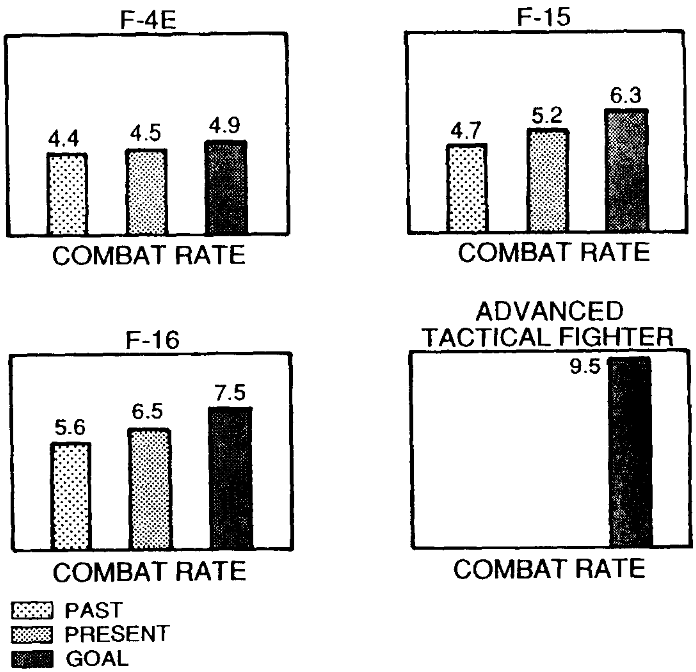
- Increase war-fighting capability.
- Decrease vulnerability of the combat support structure.
- Decrease mobility requirements.
- Decrease manpower requirements.
- Decrease costs.

The abbreviated goal statement means that next-generation systems should be twice as reliable and require half as much maintenance as the generation they replace.[25]

Reliability affects the need for spare parts, levels of maintenance, and operational accuracy. Maintainability affects system turnaround times, system training needs, support equipment, supply pipelines, maintenance force size, and location of repairs. Reliability is generally associated with performing an assigned task over time, cycle, or event and can be expressed in terms of mean time between failures (MTBF), mean time between repair (MTBR), or mean consecutive sorties between major maintenance (combat rate).[26]

Figure 24 is a comparison of the combat rate of the current active TAF fighters (not tracked by ANG) to the projected rate of the advanced tactical fighter (ATF).[27] The increase in performance over time, indicated for progressively newer systems, is directly proportional to combat capability, which interrelates to the other stated goals of R&M.

Upgrades and retrofits using improved R&M can have a significant effect on the combat capability of existing systems as well. The programmable signal processor for the F-16 is being upgraded from a 200-hour to a 2,000-hour MTBF.[28] User feedback provides fertile ground for R&M improvements and should be cultivated to the maximum extent through emphasis on such things as the suggestion program, product improvement working group (PIWG), system safety groups (SSG), and the Blue Two program.



Source: Viccellio 1990 briefing.

Figure 24. Reliability (Combat Rate: Mean Consecutive Sorties between Major Maintenance—Active Duty TAF)

A suggestion by an Air National Guard maintenance member involved a modification to the aircraft liquid oxygen servicing panel. Here is the story:

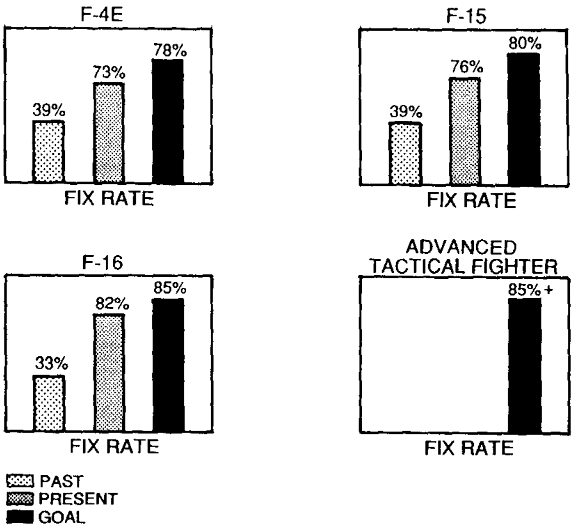
> This servicing panel had twenty-one fasteners to be removed and replaced in order to service liquid oxygen on the aircraft. It took approximately twenty minutes to accomplish this remove-and-replace task during the servicing procedure. Liquid oxygen servicing is a task that must be performed before each A-10 flight. . . . He suggested that a smaller panel with only two fasteners and a hinge be installed on the original liquid oxygen servicing panel. His suggestion was adopted and now the panel can be removed and replaced in about one minute. During the course of one year, this single modification will save the United States Air Force approximately 63,000 maintenance manhours in removing and replacing just this one panel.[29]

There are many other success stories like this that can be told about ideas that save manpower and time. We must continually emphasize their importance through encouraging participation and involvement by our users in appropriate programs. The less time an aircraft spends on the ground the more time it is available to spend over targets. A combat rate of 9.5 sorties or more for fighters and 30 days of operating time without critical failure for ground radars should be attainable in the future. The Air Force special assistant for reliability and maintainability, Brig Gen William Collins, put it this way: "If you double reliability, you only need half as many planes to do the same job."[30] The same kind of logic can be applied to the levels of maintenance required and the maintenance force size.

Maintainability, which is usually associated with cost and with the effort of sustaining the assigned performance, can be expressed in terms of the number of aircraft that can be repaired within a designated period of time (the fix rate) and the maintenance man-hours per flying hour (MMH/FH). For example, more than 85 percent of ATF maintenance problems should be fixable within eight hours as opposed to the current fix rate of the F-16 at 82 percent, the F-15 at 76 percent, and the F-4 at 73 percent (fig. 25).[31] From another perspective, the ATF system requirements call for an 8- to 10-percent break rate compared to 15 percent for the F-15.[32] Correspondingly, the ATF maintenance personnel requirement is anticipated to be 16 manpower spaces per aircraft, as opposed to approximately 23 for the F-16, 24 for the F-15, and 26 for the F-4 (fig. 26).[33]

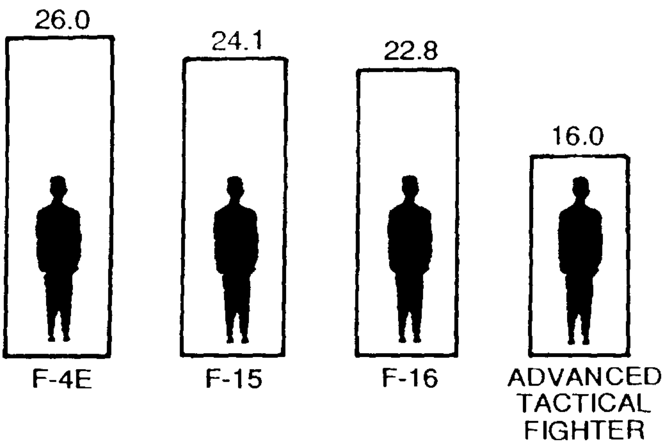
Reliability and maintainability achievements have become one of the driving factors in reviewing the way we are structured to do business in the future. Other driving factors that are outside the scope of this research work are fiscal constraints and growth in productivity.

The key to cutting the logistics tail and restoring flexibility to our forces is to reduce the complex, vulnerable, intermediate-level combat support structure. In his address at the 1985 Aeronautical



Source: Viccellio 1990 briefing.

Figure 25. Maintainability (Fix Rate: Aircraft Breaks Fixed within Eight Hours)



Source: Viccellio 1990 briefing.

Figure 26. Manpower Spaces per Aircraft

Systems Division Program Manager Awards banquet, Lt Gen Leo Marquez, Headquarters USAF/LE, put it this way:

> The hallmark of airpower in every war since airpower's emergence has been mission flexibility—and that flexibility is being eroded away by dependence on highly trained specialists and complex intermediate shops. You must reckon with this as you bring on board the systems of the future. People and expensive equipment are no longer easily replenished resources.[34]

The best method of achieving the R&M goal of reduced vulnerability of airfield maintenance shops along with their infrastructure is to eliminate the need for them. "If support structures don't have to be in place, they are not vulnerable."[35] R&M provides a means to attain this objective.

Onboard oxygen generating systems (OBOGS) eliminate the current requirement for liquid oxygen (LOX) plants, reducing the number of personnel and changing the structure required for storage, delivery, and servicing of aircraft and associated equipment.[36]

The KC-135 reengining program involving the new F108 engine has already saved 50 manpower spaces in the Strategic Air Command, with an additional savings of 40 more spaces expected by 1991.[37]

Defense industry contractors developing the engine prototypes for the ATF are greatly simplifying designs that reduce required maintenance actions. Pratt and Whitney's entry in the competition is designed to have 40 percent fewer parts, require 60 percent fewer depot- and support-level tools than current engines, and contain main engine components that can be replaced within 20 minutes.[38]

Manpower requirements are saved through improving both reliability and maintainability. In fact, the USAF is expected to be able to maintain its new systems with one-third to one-half the personnel required to maintain current systems. Furthermore, the fighter electronics reliability goal, whether a new or upgraded line replaceable unit, is 2,000 hours MTBF. According to an Air Force R&M overview report, many operating commands believe

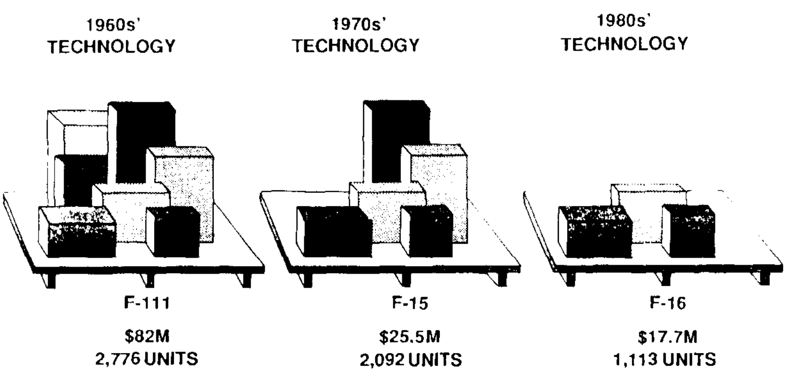
meeting this projected goal "would eliminate the requirement for intermediate-level maintenance." [39]

Technology

As force multipliers, R&M and technology advancements combined can have a significant impact on the organizational picture of the future. Figure 27 illustrates their effects on the cost and number of spares required to support the F-111 of the 1960s, the F-15 of the 1970s, and the F-16 of the 1980s. During those three decades there was a 60-percent reduction in the number of spares and a 78-percent reduction in the cost of the war readiness spares kit (WRSK).[40]

R&M achievements are central to the issue of reduced spares, costs, and intermediate-level maintenance requirements on one side of the equation. On the other side is improved combat capability and force structure efficiency.

Emerging technology applications have been the linchpin of R&M success stories in the past. High technology improvements will become even more important in the austere operating



Source: Viccellio 1990 briefing.

Figure 27. R&M/Dyna-Metric Improvements: Squadron Wartime Spares Kits

environment of the future as they are applied to systems that have a direct impact on the support structure.

Besides being the key to R&M improvements, technological developments support the emphasis on reviewing the need and form of intermediate-level maintenance in the future. New weapon systems are being designed, and existing ones modified, to incorporate the use of very high speed integrated circuits (VHSIC), for example. This new technology not only dramatically improves reliability but directly affects how we need to be structured to maintain the improved systems. The on-aircraft avionics intermediate shop (AIS), using VHSIC technology, has the capability to monitor and make diagnostic tests of aircraft systems during flight. It can store this data and make it immediately available to maintenance personnel after the flight. This technology can thus eliminate the need for components to be removed and delivered to an intermediate-level shop for off-equipment troubleshooting and repair. Under these circumstances, the technician at the organizational level could determine the problem by retrieving the stored data and making a decision to either remove and replace the component(s) or perform on-aircraft repair.

The Air Force is also studying robotics technology for possible use in combat and logistics support to include such tasks as preparation of aircraft for flight, missile maintenance and readiness, ground radar and communication systems maintenance, space activities, and depot maintenance. The Air Force Studies Board, a division of the National Research Council,[41] initiated a study in January 1987, the results of which were released in June 1989. The report concluded:

> The introduction of widespread use of robots into the existing Air Force environment will require understanding, persistence, and a willingness to change. The single most important conclusion drawn from this study is that there must be an organizational focus at both the individual facility level and at higher levels.[42]

Furthermore, the report cited examples of robotic applications that could be aimed at easing manpower-intensive or extremely

hazardous tasks. Aircraft deicing, a time-consuming and hazardous task, could be accomplished by using a robotic spray arm and television camera, which would eliminate the need for a human operator. External aircraft fuel tank assembly is a man-hour-intensive operation. "A squadron of 24 aircraft flying 50 sorties a day would require 100 man-hours to do nothing but assemble drop tanks. Redesign of drop tanks to use robotic assembly would save most of the manpower."[43]

Robots designed to operate in conjunction with the new neutron-ray technology could eliminate the need for man-hour-intensive procedures to perform foreign object damage (FOD) and nondestructive inspections of fighter aircraft. Currently, major disassembly of aircraft flaps, landing gear, engine, and seats has to be accomplished to perform required inspections for corrosion, foreign object damage, or cracks. Robots could change these time-consuming procedures. Only if a problem is found after the aircraft is inspected intact would disassembly have to be accomplished for further study.[44]

Principal Objections to the Adoption of COMO

It becomes readily obvious that future changes in organizational structure must be made in the context of the effect those changes have on the other variables that form the framework of an organization and the external environmental situation. Reorganization of ANG TAF maintenance units is not without its critics. Those who believe that "if it ain't broke, don't fix it" are apparently content with the status quo and are determined to resist any progressive effort to continuously improve their organization if such change violates their comfort zone. The four principal objections to moving in the direction of changing the TAF maintenance organization to mirror the gaining-command structure are (1) it will require large numbers of additional personnel and place an unacceptable burden on recruiting, (2) it

will result in excessive training requirements, (3) on- versus off-equipment work will result in a loss of expertise, and (4) ANG maintenance units are already organized to mobilize as tasked.

Manpower and Recruiting

I agree that the manpower requirements to support a reorganization of the COMO in the early 1980s would have involved increased numbers of personnel. At that time, all ANG unit military manning documents were based on man-hour per flying hour requirements. A standard number of flying hours was allocated to a flying unit based on aircrew training requirements and PAA numbers. The authorized direct labor man-year positions (ADLMP) for the maintenance unit were determined by dividing the direct labor maintenance man-hours per flying hour by a man-hour adjustment factor with additions made to account for the indirect labor production and special support activities such as the DCM staff, engine tracking, munitions, AGE, and electronic countermeasures equipment.[45] The active TAF maintenance manpower standard was determined by a computer modeling technique called the logistics composite model (L-COM), which simulated a variety of flying, maintenance, and other related aircraft activities of a flying unit by using operations, maintenance, and supply data.

The MMH/FH method was cumbersome, complex, and less indicative of realistic manpower needs than L-COM, and it produced a substantial disparity in the number of manpower positions between the ANG and active TAF. The MMH/FH method, for example, set the maintenance manning authorization for an ANG flying unit with 18 A-7 PAA and 310 personnel. In contrast, the L-COM method determined the maintenance manning authorization for the same unit to be 513. Similar differences existed between other ANG and active TAF flying units.[46]

The L-COM process has been validated over the last ten years and is now accepted by the ANG for a centralized peacetime and

wartime scenario. L-COM standards for all weapon systems have not yet been developed, but ANG manpower modeling has been modified and updated during this same time period. The Guard must transition completely to L-COM techniques as soon as they are developed because the MMH/FH method is no longer valid or supportable of the Air Force Studies Board process.

The peacetime maintenance manpower comparison depicted in table 1, chapter 3, reflects the results of improved modeling techniques currently used by the ANG while the active TAF figures were determined by L-COM in every case. In the future, however, application of L-COM modeling to all ANG TAF units should nearly equalize manpower requirements when like weapon systems are compared. Note that with the newer weapon systems like the F-15 and F-16, owned by both ANG and active TAF, there is only a 3-percent average difference in manpower requirements of like mission, design, and series (MDS), with the advantage to ANG units. The significant differences in manpower requirements are in the F-4 and A-10 MDS. As the F-4 is phased out and replaced by F-16s, those differences will disappear.

The A-10 manpower disparity can be rationalized by examining the difference in how the ANG uses the aircraft compared to the active TAF. In the active TAF, the A-10 is utilized as a close-air-support (CAS) aircraft. In the ANG it is used in both the CAS and tactical air control roles. The tactical air control mission requires fewer maintenance manpower spaces than the CAS mission, thereby accounting for the current disparity. Future plans to entirely convert A-10 use to only the tactical air control role should make this a moot point.

With all else being equal, the gradual transition of current ANG manpower modeling techniques to the use of L-COM standards and the continued conversion of ANG TAF units to newer weapon systems should negate any significant burden on recruiting as a result of structural changes to the maintenance organization.

Training

It is true that increased numbers of personnel acquired by the ANG would increase the acquisition and training costs. An assessment of a sampling of those costs is contained in chapter 3. Our senior leadership would have to make a decision as to whether the costs are acceptable in light of fiscal constraints and in terms of our capability to maintain readiness.

Another objection to the adoption of a COMO-type structure is cross-utilization training. The synergistic effects of R&M achievements, technology, and management and leadership initiatives have made it possible to go to Rivet Workforce because with fewer breakdowns in equipment the technician will have much more time between maintenance actions. This additional time can be better utilized if the technician is not highly specialized and can work on other related systems. Under the COMO, and with the integration of Rivet Workforce, aircraft maintenance has been separated into on- and off-equipment functions, which means that technicians must broaden their skills to be capable of being cross-utilized in more than one system.

Initially, cross-utilization training will increase the OJT work load because all E-6s and below will have to complete additional career development courses. In the long run, however, upgrade training requirements remain about the same and actually decrease in some cases. The integration of avionics and consolidation of skills reduced career development course requirements from 11 to nine volumes.[47] Additionally, the full-time military technician, who constitutes one-third of the ANG maintenance force, will be capable of a relatively quick transition since most are already trained/skilled in cross-utilization tasks performed routinely on a day-to-day basis.

To overcome the disadvantage of an increased and more complex training work load attendant to RWF, we need to train smarter. "In many areas the business of training hasn't changed for 20 years," says Maj Mike Meyer, another RWF planner. "We are still using the old method of having an instructor stand in front of a class and lecture, which ties up someone who could better be

used on the flight line and does not recognize individual student abilities."[48] Major Meyer further stipulates that we have saturated the system by teaching OJT in some areas that formal training should cover. A companion program that parallels RWF, called Rivet Train, was launched by the Air Staff to review training in the aircraft maintenance career field to determine the realistic, baseline training requirements generated by RWF and all other maintenance training. Existing training technology is being explored for its application to maintenance training requirements. Among these are the interactive videodisc, computer-assisted instruction, and computer-based instruction. Intelligent exploitation of these and other more advanced techniques should help us train more efficiently to ensure maintenance personnel have the skills to do their job in the future.[49]

On-Equipment versus Off-Equipment Work

The division of work into on- and off-equipment functions will definitely reduce specialization but not necessarily overall expertise. Technicians will learn practical related skills on aircraft assigned to the unit contrasted with their previous study of the same skill for various aircraft through career development course material.[50]

We can no longer afford the large, complicated infrastructure required to support highly specialized maintenance activities. There has to be a trade-off between the degree of specialization and the utility of consolidating skills in order to enhance combat capability, reduce costs, and reduce vulnerability of the support structures.

Mobilization

Air National Guard flying units are organized as autonomous squadron-sized units that are tasked to mobilize and deploy as an aviation package according to the unit type code. Under current war plans, the majority of ANG units gained by the TAF deploy

to bases where they either operate alone or are hosted by NATO, Air Force Reserve (AFRES), or other ANG forces. Very few such units deploy to a forward operating location or main operating base having regular USAF forces. On the surface it appears that we are organized in peacetime as we would have to be in wartime. However, the current tasking is based on the needs of the past. The world situation is changing almost on a daily basis and in ways no one ever imagined. Withdrawal of hundreds of US troops from Europe and Asia has created the perception of an entirely different and reduced threat to our national security. NATO is changing to a different form as a result of this perception and members are reducing the percentage of their budgets spent on national defense and the military. These stunning changes will result in drastically different tasking for which we must be prepared to adjust. The ability to maintain constant readiness with the capability to deploy rapidly and fight immediately when we get there will be even more important in future conflicts.

Other considerations are the president's authority to order ANG units to active duty after declaring a national emergency, or to exercise the limited call-up of a maximum of 200,000 members to serve in the event of a war or national emergency or for other purposes such as a demonstration of rapid-response capability. In either of these situations it is possible that a unit could be mobilized but deployed within the United States to be collocated with active USAF forces. This happened in mobilizations and deployments during the Korean conflict, Berlin airlift, and Vietnam War.

During the Korean conflict, 22 ANG wings consisting of fighter, light bomber, and tactical reconnaissance units were mobilized. Three deployed to Europe, two to Korea; the 17 remaining wings provided support and replacements from the continental United States (CONUS). In response to the war in Vietnam and the USS *Pueblo* crisis, 14 ANG fighter, tactical reconnaissance, and support units were mobilized, 35 percent of which deployed to Vietnam, 60 percent to Korea and Japan, and the remaining 5 percent provided support and replacements from CONUS bases.[51]

It is also possible, if not highly likely, that current tasking will be revised, resulting in many more ANG TAF units deploying to overseas locations. This would require efficient and effective integration with USAF forces.

Finally, day-to-day training requirements call for organizational similarities to facilitate effective training. On 21 August 1970, when Secretary of Defense Melvin Laird announced the Total Force concept, training became an Air Reserve Forces mission by regulation. AFR 45-1, *Purpose, Policy, and Responsibilities for Air National Guard and Air Force Reserve*, 2 January 1987, states that the ANG and the United States Air Force Reserve (USAFR) mission is

> to train and provide combat flying units, combat support units, and qualified personnel for active duty in the Air Force:
>
> a. To support wartime requirements.
>
> b. To perform such peacetime missions as are compatible with Guard and Reserve training requirements and the maintenance of mobilization readiness.
>
> c. To conduct training in support of Total Force capabilities.[52]

A recent example of ANG peacetime requirements to integrate with active forces was Creek Klaxon. While collocated with an active fighter unit for one year, ANG TAF units performed air defense alert and trained daily with the Air Force.

During wartime contingencies, the time required to integrate dissimilar organizations and handle associated management problems would interfere with a flying unit's capabilities to rapidly and effectively engage in war fighting immediately after arrival at the deployed location.

Our combat capability can be maximized by organizing and training in peacetime like we intend to fight. An organizational structure similar to the active TAF structure will facilitate a smooth integration upon mobilization, enhance peacetime training, and fully comply with the intent of the gaining command concept.

The Restructured Maintenance Organization: What Should It Look Like?

The transition of the ANG maintenance organization to a COMO-type organization must be evolutionary rather than revolutionary. R&M, new technology, and management and leadership initiatives are rapidly changing the environment and the way we do business. A different organization and structure will have to evolve from the rapidly changing environment and organizational framework variables.

To start the evolutionary process, I believe the ANG has to investigate three options to determine the feasibility for implementation. First is to change the structure and organization now to exactly match COMO. The second option is to change nothing. Leave the organization as it is. The third option is to make phased incremental enhancements to the organization, each phase designed to continually move the organization toward a more decentralized COMO-like structure.

The option to make an exact change to COMO would be inadvisable. The sudden action to reorganize and restructure would be too drastic a shock to the organization and would cause confusion and havoc. The current full-time work force is probably too small to adequately man all areas in a COMO organization. Unless the organization is given time to adjust, the reorganization attempt would be doomed. A direct conversion would adversely impact the military technicians by position downgrades, reduction in force, reduced efficiency, union intervention, and lower morale.

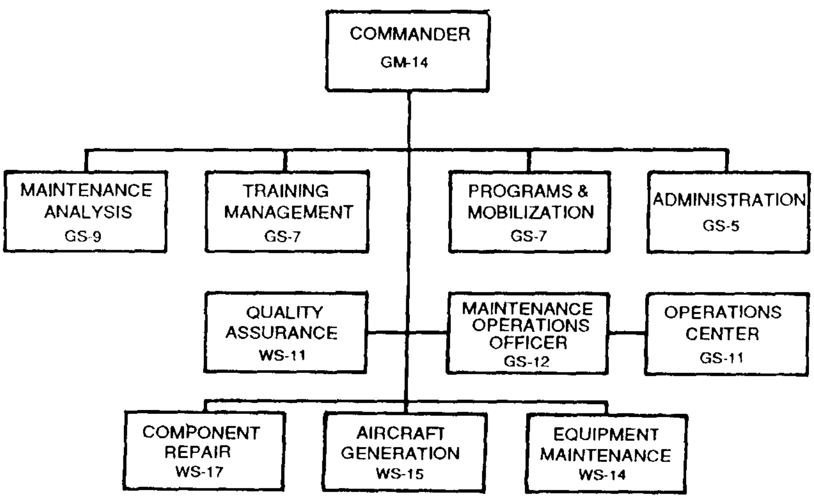
The option to maintain the status quo would be a serious mistake. It is the direct opposite of immediate change. The rigidity in our current organizational structure would cause problems and prevent necessary change at the very time when phenomenal changes are occurring in the environment. The organization would become unresponsive, inefficient, and incapable of meeting redefined mission requirements in the future.

The third option, to make phased incremental enhancements to the organization, is the only valid one. Since the immediate

post-Vietnam era, the tactical air forces, which include those of TAC, SAC, PACAF, USAFE, the Eleventh Air Force, and the Air Force Reserve, have all reorganized aircraft maintenance and supply to various degrees with the intent of decentralizing authority. The result has been improved unit efficiency, teamwork, decision making, leadership development, and resource availability on the flight line.

The Air Force Reserve has been reorganized along COMO lines with certain exceptions. Figure 28 illustrates its current TAF organization structure. Assigning civilian specialists to their respective shops during day-to-day operations and dispatching them from the maintenance operations center continues to reflect their use as both on- and off-equipment technicians. During extended exercises and annual field training with the entire military organization, or elements thereof, they revert to the formal MCR 66-5 (COMO) organization.

The Strategic Air Command has also followed the trend to decentralize aircraft maintenance along the same lines as TAC but



Source: MCR 66-5, 1–6 through 1–11.

Figure 28. Air Force Reserve TAF Maintenance Organization

tailored to their unique mission requirements. The Readiness-Oriented Logistics System (ROLS) was tested in 1985 at a SAC base as a part of the model installation program (MIP) and was approved later in 1986 for implementation. SAC's Office of Manpower and Organization (XPM) explained the ROLS concept this way:

> The overall objective of ROLS is to combine "on-aircraft" specialists and dedicated crew chiefs into the Organizational Maintenance Squadron, and to affix authority and responsibility for aircraft production with a "line chief" on the flightline. . . . "Off-equipment" maintenance specialists will be combined into two other squadrons, the Field Maintenance Squadron and the Avionics Maintenance Squadron.[53]

The SAC action office proposing the reorganization further states in its staff summary sheet, "The ROLS reorganization is structured to improve aircraft readiness through increased efficiency on the flightline. This concept reduces decision making authority to the lowest level possible." The proposal to adopt ROLS was made with no changes in total grades or skills but in some cases required new construction of buildings or modules under the military construction program (MCP).[54]

I recommend that ANG aircraft maintenance also be reorganized for the same reasons stated here with the added purpose of improving integrated training and mobilization with the active gaining commands. To begin the transformation, the ANG should first designate several maintenance organizations to conduct a controlled one-year test of the adequacy and feasibility of a restructured organization, to include COSO, possibly like the ones depicted in figures 29 and 30. The test organizations should incorporate the basic tenets of COMO/ROLS allowing for decentralized responsibility and authority and an on-/off-equipment structure that consolidates the sortie production effort into the aircraft generation function. Consolidation of skills/ AFSCs and the consolidation of the overall work force into on- and off-equipment functions should be major test parameters.

The categories of the various functional elements of the test organization structure should be designated the same as those of

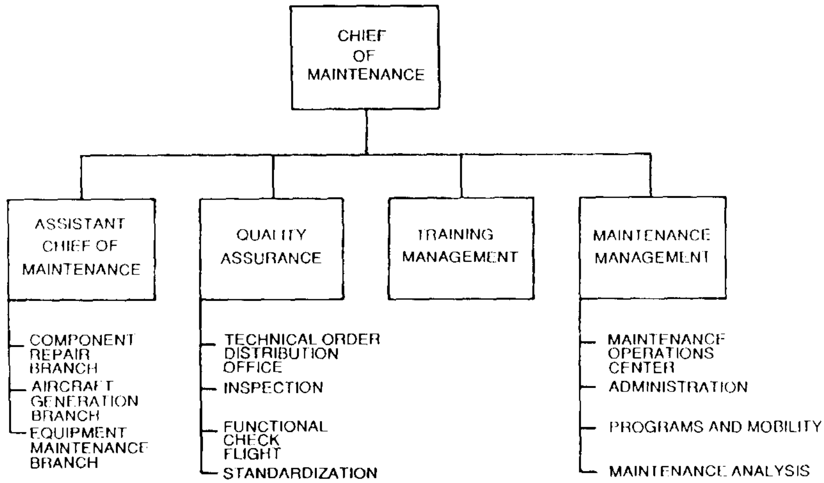


Figure 29. Restructured ANG Maintenance Organization: Staff Functions

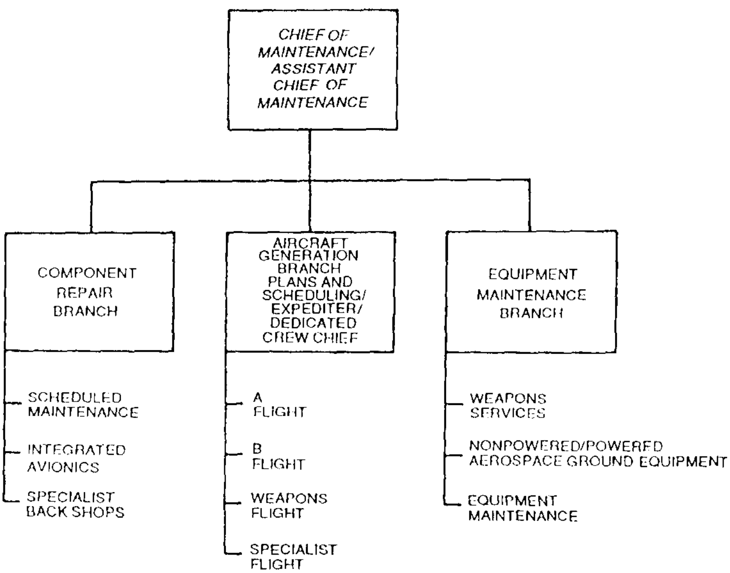


Figure 30. Restructured ANG Maintenance Organization: Production Functions

COMO/ROLS and consolidated as indicated in figure 29 into the component repair branch (CRB), the aircraft generation branch (AGB), and the equipment maintenance branch (EMB). The centralized authority that maintenance control has now should be decentralized to allow decision making at the dedicated crew chief level on the flight line with a redesignated maintenance operations center monitoring and coordinating maintenance actions. Concurrently with this decentralization in maintenance control, two people from job control and one person from plans and scheduling should be relocated to the AGB to perform scheduling and expediting duties.

After the test is concluded, the next step should be to conduct a thorough evaluation of the results to determine if the decentralized organization is considered feasible after appropriate course corrections. Finally, determine whether to initiate a planned, phased transition to convert all applicable TAF and possibly SAC maintenance units to the restructured organization. H. Edwards Deming says that the organization of the 1990s must develop the capability to maintain consistent, repeatable production processes—to prevent change—and, at the same time, to "continually transform its processes, systems, and structures to take competitive advantage of ever-diminishing periods of environment stability." [55]

I can envision evolving out of this turmoil and dynamic environment at the turn of the century an ANG maintenance organization that has modern equipment and that exploits achievements of R&M, advances in technology, and improved management techniques from TQM and other initiatives to produce a flatter skeletal framework with a leaner staff. I can see a greater degree of decentralization that would allow for quick decisions and would develop leaders. I can see action teams that provide for enhanced lateral communications and that give people a stake in the organization. And I can see the use of alternative maintenance concepts taking advantage of Rivet Workforce consolidation and eliminating intermediate-level maintenance to produce a smaller and more efficient maintenance organization,

the structure of which matches that of the active gaining commands to the greatest extent possible.

Notes

1. Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence: Lessons from America's Best-Run Companies* (New York: Harper and Row, Inc., 1982), 9–11.

2. Ibid., 11.

3. Ibid., 10.

4. Department of Defense, *Reserve Component Programs, Fiscal Year 1988*, report of the Reserve Forces Policy Board, Washington, D.C., 1989, 24.

5. James M. Hurley et al., "USAF Executive Leadership and Management Initiatives," research report (Maxwell AFB, Ala.: Air War College, 1985), 12.

6. Briefing, Lt Gen Henry Viccellio, Jr., Senior Leaders Maintenance Course, Langley AFB, Va., May 1989.

7. Hurley, 35.

8. Viccellio briefing.

9. Hurley, 35–36.

10. Viccellio briefing.

11. Ibid.

12. Ibid.

13. Briefing, Lt Gen Henry Viccellio, Jr., subject: Combat Support and the Air Force Logistics Conflict of Operations, Air War College, Maxwell AFB, Ala., March 1990.

14. Ibid.

15. Secretary of Defense Dick Cheney, *Defense Management: A Report to the President* (Washington, D.C.: Department of Defense, July 1989), 1.

16. Ibid., 15–16.

17. The actions taken by the successful organizations involved in the DOD corporate review relate directly to what Peters and Waterman define as organizational hardware (strategy and structure) and software (style, systems, staff [people], skills, shared values [culture]). All of these variables are interdependent; therefore, a change in one affects the others. See Peters and Waterman, 11.

18. Cheney, 16.

19. Jack Katzen, "Total Quality Management Implementation," in *Total Quality Management Implementation: Selected Readings* (San Diego, Calif.: Naval Personnel Research and Development Center, April 1989), iii.

20. Edward M. Baker, "The Quality Professional's Role in the New Economic Age," *Quality Progress*, November 1987, 20.

21. Ibid.

22. Ibid., 22–24. Baker has a detailed explanation of how the functional hierarchy inhibits quality and the proliferation of complexity with vertical height in an organization.

23. Ibid., 21.

24. Jerry C. Crane, "The Impact of Reliability on Life Cycle Cost" (Unpublished paper presented by the deputy assistant for reliability and maintainability, AFLC, at the Fifth Symposium on Quality and Its Assurance, Madrid, Spain, 29 May–2 June 1989), 5.

25. Peter Grier, "R&M Is Serious Stuff," *Air Force Magazine*, November 1989, 96.

26. Crane, 2.

27. Viccellio 1990 briefing.

28. Grier, 98.

29. Crane, 6.

30. Quoted in Grier, 98.

31. Viccellio 1990 briefing, B-6.

32. Grier, 96–98.

33. Viccellio 1990 briefing, B-11.

34. Quoted in *The Logistics of Waging War: American Logistics, 1774–1985*, ed. Lt Col David C. Rutenberg and Jane S. Allen (Gunter AFS, Ala.: Air Force Logistics Management Center, 1986), 195.

35. Grier, 98.

36. Ibid.

37. Ibid.

38. Ibid.

39. Ibid.

40. Viccellio 1990 briefing.

41. The National Research Council is a private, nonprofit research organization chartered by Congress to advise the government on scientific and technical matters. Air Force Systems Command contracted the council, which in turn had the Air Force Studies Board perform the study of Air Force use and need for robotics. See John Ginovsky, "Robotics," *Air Force Times*, 18 December 1989, 15.

42. Ibid.

43. Ibid., 16.

44. Ibid.

45. Minutes of the 2d Semiannual A-7 Maintenance Council Meeting, Manpower Committee Report at OC-ALC, Tinker AFB, Okla., 2–3 December 1985.

46. Extracted from an ANG/LGM position paper on COMO, undated.

47. Lt Col Larry Jones, NGB/LGM point paper on Project Rivet Workforce, 14 October 1987.

48. Quoted in Jim Garamore, "Rivet Workforce: Program to Review Aircraft Maintenance Training," *Air Force Times*, 31 March 1986, F-1, F-2.

49. Ibid.

50. Peter B. Cascio et al., "Organizing the Air Force: Reserve Components," research report (Maxwell AFB, Ala.: Air War College, 1989), 14–15.

51. Ibid., 3.

52. Ibid.

53. Staff Summary Sheet, Headquarters SAC/XPM, Request for Waiver to AFR 26-2, 1986.

54. Ibid.

55. Quoted in Baker, 20.

Glossary

ADLMP	authorized direct labor man-year position
ADT	active duty training
AEMS	armament and electronics maintenance squadron
AFLC	Air Force Logistics Command
AFT	annual field training
AFRES	Air Force Reserve
AFSC	Air Force specialty code
AGB	aircraft generation branch
AGE	aerospace ground equipment
AGS	aircraft generation squadron
AIS	avionics intermediate shop
ALC	Air Logistics Center
AMB	avionics maintenance branch
AMU	aircraft maintenance unit
AMUSS	aircraft maintenance unit support section
ANG	Air National Guard
ANGSC	Air National Guard Support Center
APG	airplane general
ARI	Airpower Research Institute
ATF	advanced tactical fighter
BA	budget authority
BMT	basic military training

CAMS	consolidated aircraft maintenance squadron
CAS	close air support
CND	could not duplicate
COMO	combat-oriented maintenance organization
COSO	combat-oriented supply organization
CRB	component repair branch
CRS	component repair squadron
DCC	dedicated crew chief
DCM	deputy commander for maintenance
DIFM	due-in from maintenance
DML	director of maintenance and logistics
DMR	Defense Management Review
EMB	equipment maintenance branch
EMS	equipment maintenance squadron
FCF	functional check flight
FMB	field maintenance branch
FMC	fully mission capable
FMS	field maintenance squadron
FOD	foreign object damage
IDT	inactive duty training
L-COM	logistics composite model
LME	local manufactured equipment
LOX	liquid oxygen

LRU	line replaceable unit
MCP	military construction program
MDS	mission, design, and series
MICAP	mission capability
MIP	model installation program
MMB	munitions maintenance branch
MMH/FH	maintenance man-hours per flying hour
MMS	munitions maintenance squadron
MOC	Maintenance Operations Center
MOD	maintenance operations division
MS&D	materiel storage and distribution
MSK	mission support kit
MTBF	mean time between failures
MTBR	mean time between repair
OBOGS	onboard oxygen generating system
OJT	on-the-job training
OMB	organizational maintenance branch
OMS	organizational maintenance squadron
ORI	operational readiness inspection
PAA	primary authorized aircraft
PACAF	Pacific Air Forces
PCS	permanent change of station
PIWG	product improvement working group
POMO	production-oriented maintenance organization

P&S	plans and scheduling
R&D	research and development
R&M	reliability and maintainability
RCM	reliability-centered maintenance, or repair cycle monitor
RCSU	repair cycle support unit
ROLS	Readiness-Oriented Logistics System
RVN	Republic of Vietnam
RWF	Rivet Workforce
SAC	Strategic Air Command
SRU	shop replaceable unit
SSC	system support contractor
SSG	system safety group
TAC	Tactical Air Command
TAF	tactical air forces
TODO	technical order distribution office
TQM	total quality management
USAFE	United States Air Forces in Europe
UTA	unit training assemblies
UTC	unit type code
VHSIC	very high speed integrated circuit
WRSK	war readiness spares kit

Index